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"To the solid ground
Of nature trusts the Mind that builds for aye"—WORDSWORTH

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FOOD AND THE STRATEGY OF PEACE

THE United Nations Conference on Food and Agriculture which has just ended at Hot Springs, Virginia, brought together representatives of forty-four nations to consider the world problem of food distribution after the War. It has been described, not inaccurately, by the editors of *Fortune* as the first of the peace conferences to end the War, and for the first time in history we are witnessing the planning of the strategy of peace while the objectives of war are still far from their fulfilment. The Conference has yet to be followed by action, it is true, but on its face value its declarations and decisions give reasonable ground for the belief that an important blow has been struck for sanity in world economics.

The recommendations show that most of the time and expert knowledge of the delegates to the Conference were devoted to the problem of providing more and better food for 2,000 million people to eat. Almost all their proposals for the expansion of production, the improvement of nutrition and the increase of consumption are specifically directed to this end. The prior charge on each country will be to provide the foods of high nutritional value such as milk, other dairy produce, vegetables and fruit, which are mostly perishable and best produced as near as possible to the centres of production. The want and need of these protective foods is almost unlimited. Beyond this basic domestic priority, consumption needs must be met from the most efficient sources of production wherever they may be found, with specific safeguards for the conservation of soil and its fertility.

Essentially this programme is a manifesto for freer trade and the international division of labour. Equally it is a programme of full employment—the development of industries and of purchasing power in backward areas as well as the maximum output of the right foodstuffs in the right places. It is not a policy of *laisser-faire* or of cut-throat competition, and although guarantees of stable prices to efficient producers to prevent the collapses which have been a bane in the past are essential to success, the protection of producers and restriction of supply by high tariffs or quantitative restrictions on imports must be firmly excluded. The protection of consumers and the maintenance of demand by social security measures or subsidies to special classes must be the weapons of policy.

The principal decision of the Conference is the creation of a permanent international organization, on the lines of the International Labour Organisation, to secure collaboration on measures to increase production, distribution and consumption of food. Until the permanent organization can be established, an interim commission is to function in Washington, meeting not later than July 15. This Commission will be responsible for the promotion and co-ordination of research, and for the collection and dissemination of information. It will submit to the individual Governments recommendations for action along the lines agreed by the Conference, and will examine such questions as the development of agricultural resources, commodity arrangements, consumer co-operatives, land tenure and other subjects considered at the Conference.

Besides this section concerned with the permanent machinery to implement its recommendations, the Conference was organized in three other sections, each divided into a number of committees, responsible for examining particular aspects of the general problem.

The report of the first section, on consumption levels and requirements, stresses the relation between malnutrition and poverty and gives a picture of "world-wide under-consumption, malnutrition and its attendant evils". Three-quarters of the 1,150 million inhabitants of Asia are living below decent health standards; malnutrition exists among the lower income groups of the United States and Europe; there are widespread deficiencies in tropical Africa, the West Indies and other colonial territories, and the War has aggravated a situation already serious. Without formulating a uniform set of dietary standards for general application, certain broad principles are laid down, and such standards as those evolved by the League of Nations Technical Commission on Nutrition are universally applicable. Advances in nutritional science permit the establishment of minimum dietary requirements in terms of calorie, protein, mineral and vitamin content. Government promotion of systematic education in food values, special provision for pregnant women, nursing mothers, infants and adolescents and the development of community services, school meals and factory canteens are recommended.

The second section, which examined the expansion of production and adaptation to consumption needs, distinguishes between the short-term and the long-term objectives. First, it recommends an immediate increase wherever possible in the acreage of crops for direct human consumption, even at the expense of postponing the replenishment of livestock herds. While the shortages continue, the governments, individually and collectively, should endeavour to co-ordinate national production policies and the means of transport and distribution, and should take measures to prevent speculation and price fluctuations. Countries which, owing to their freedom from the impact of war, have been producing more than their normal output should maintain or expand their production and develop the manufacture of farm machinery and fertilizers.

The period of transition will involve considerable adjustments in policies. The long-term policy of each nation should be to increase the efficiency of production through better farming methods, measures for soil conservation, the encouragement of research, and the exploitation of undeveloped areas through land clearance, drainage and irrigation projects; and to introduce changes designed to foster the production at home of protective and relatively perishable foodstuffs. Nations should not attempt artificially to produce nutritionally desirable foods which can easily be obtained elsewhere. Besides measures designed to improve agricultural efficiency and promote research, this section of the Conference recommends that, to facilitate occupational adjustments, countries with large populations in relation to their agriculture should develop suitable industries for processing and preserving their own produce, and should be assisted to export processed articles rather than raw materials, and to import machinery and tools.

The recommendations of the third section, on the facilitation and improvement of distribution, are less definite, depending as they do on international agreement in the wider field of reconstruction. The Conference recognizes that the key to the long-term problem lies in full employment, with generally increased purchasing power and improved standards of living. The need for maintaining a balance between agriculture and industry is recognized, and international trade barriers and restrictions are denounced. In the immediate post-war period it will be necessary to ensure the most economic distribution of available supplies and to avoid price fluctuations and unrestrained competition. Under-nutrition will necessitate international action on a large scale, and international commodity arrangements will be necessary: these should allow effective representation of consumers, the maintenance of adequate reserves and the orderly disposal of surpluses. Other recommendations are international standardization in methods of processing, preserving, storing, packing and transport; measures for protecting the consumer from unfair trade practices; and full use of such war-time developments as dehydration.

So much for the general programme, the technical soundness of which can scarcely be questioned. The translation of recommendations into action, however, involves the overcoming of long-standing political obstacles, national and sectional. While, for example, the maintenance of health in Britain during the War shows what can be achieved through a scientific nutrition policy and the planned distribution of basic foodstuffs, in Britain no less than elsewhere agriculture is unbalanced and distorted, and with vested interests created in uneconomic farming. The farming forced on nations by war-time scarcities and the severance of communications is poles apart from the programme of abundance that co-operation and common sense could devise in a peaceful world, and is dangerously close to the narrow nationalistic aspirations of politicians and producers.

That is the first issue upon which the Governments of the world must fasten. To translate into specific terms this vision of an efficient and fruitful world agriculture, based on the expansion of world production according to a functional division of tasks, will demand not only all the help that the proposed permanent international organization can give it, but also the understanding support of public opinion everywhere. That the public interest must overlay discussion is a principle that must be firmly applied. Fortunately there are already welcome signs that education in this matter is proceeding apace. The recent *Fortune* report on "Relations with Europe" is an American example. Recognition of the importance of widening the areas of free trade and, when the

Anglo-American and the European free-trade areas are well established, linking them and making them one, together with the recognition that reparations should be limited to payments in kind—the only reparations that make economic sense—are far in front of the outlook of 1919. On European economic and agricultural development the proposals of this *Fortune* report are strikingly in line with the broad trend of the Conference recommendations, and it is to be hoped that progressive opinion in Great Britain will not only welcome these proposals and recommendations but also lose no time in formulating a post-war agricultural policy in harmony with them.

The second point which requires emphasis is that the Conference reconnoitred only one sector of a large front. Originally it was intended that the Conference should confine its attention to post-war problems, but while in response to many appeals it considered also problems close at hand, it was not directly concerned with the relief measures that will be needed as new areas are liberated from the Axis. It could not ignore the problems of production which must be solved if food supplies on the scale needed to relieve hunger are to be forthcoming, but the Conference can only rightly be regarded as the forerunner of other conferences of the United Nations, the work of which will be complementary to its own in laying down the strategy of the peace.

Food strategy is only a part, though an essential part, of that wide strategy, and the new world organization to be set up will provide the indispensable general staff for research, discussion of policy and advice to Governments. It will provide the centre for the collection of statistics and information and the co-ordination of policies. Such an organization is the more essential in view of the third point that stands out from the briefest review of the work of the Conference, namely, the intimate relation of this food strategy to the strategy of the attack on the problems of unemployment, disease and other evils which stand in the way of the realization of freedom from fear and from want. So far as Great Britain is concerned, this involves the special issues put forward in the Scott Report and ultimately in the Beveridge Report. Raising the standard of living and nutrition among all the nations must have profound effects on the domestic policy of every country in agriculture. Indeed the Conference enables us to glimpse something of the framework for a policy of general advance—for the establishment of full employment and social security.

We are brought, therefore, once more to realize that, complex as are the many problems involved in the establishment of a world order of full employment, social security and freedom from want, none of the interlocked problems can be considered in isolation. We must always have regard to the wider background, national and international, into which our decisions and policies have to fit. Moreover, as the work of the Conference clearly shows, it is that wider view that really gives us hope of a solution. Seen against the background of the Hot Springs Conference, assumption *C* of the Beveridge Report has a reasonable prospect of fulfilment, and we may well hope that in further discussions on the Barlow Report, the Scott Report and the Beveridge Report, and in the overdue decisions as to the policy to be pursued, this larger background will not be forgotten but will assist in the formulation of bold policies and sound but courageous strategy.

There is evidence that this wider view is gaining acceptance. It is well put by Oswald Stein, chief of the Social Insurance Section, International Labour Office, in an article, "Building Society Security", which has recently been reprinted from the *International Labour Review*. Viewing the place of social security services in post-war reconstruction, he points out that such services should be conceived as an interdependent whole, intended to take care of, preserve and develop labour forces by ensuring their maximum productivity, and also their fair share in material progress even when their period of active participation in production has passed. Moreover, social security is limited to the aims of preventing and controlling the common risks of life, and meeting those needs which are not only vital for the individual but at the same time essential for the moral and economic welfare of society as a whole. Such limitations exclude any collective guarantee tending to diminish the vital assets of individual effort and initiative.

Into this same framework fit the cardinal objectives outlined in the *Fortune* report: peace through a common military security; freedom through a common bill of rights; prosperity through a common economic life, while here, as in the draft agreement for establishing the United Nations Relief and Rehabilitation Administration, is also the recognition that relief and rehabilitation will give the United Nations their first chance to transform their military alliance into a peaceful alliance with humanitarian and constructive aims. The relief scheme is the essential preliminary to the long-term programme of the Hot Springs Food Conference for realizing a world free from want, and it is at least a hopeful portent that the suggestions should come from an American periodical that the pooling of transport and communication facilities involved in relief and rehabilitation should be a step to the permanent unification of transport, and that the reappearance of autarchic tariffs, which clearly will not be allowed to interfere with the import of military and relief goods, should be postponed for ever.

Further evidence of the trend of American opinion can be found in the declaration adopted by the delegates of twenty-one countries at the Inter-American Conference on Social Security at Santiago de Chile in September last, which related social security to the full achievements of the four freedoms and set forth a continental programme as well as visualizing a contribution to world solidarity and the attainment and maintenance of peace. In Great Britain a recent Planning broadsheet, "Employment for All", which cannot be analysed here, makes an important contribution to the discussion first of the guiding principles of a policy for full employment and second of the operation of those principles in the setting of the immediate post-war years. Even more important is the draft agreement for the creation of a United Nations Relief and Rehabilitation Administration which the United States Government, after consultation with the British, the Soviet and the Chinese Governments, has recently put before the United Nations.

This comprehensive plan for administering relief in the wake of the armies of liberation is of importance in relation to food strategy, for several reasons. It is the first step towards a balanced economy in which a high level of consumption will prevent the piling up of great stocks of surplus goods in all the primary producing countries. Relief and rehabilitation is the opening phase of the post-war era, and the recent address of Herbert Lehman, at present director of the Foreign Relief and Rehabilitation Operations of the United States, who is expected to be the first director-general of the new organization, shows how American opinion is facing the situation.

Secondly, the proposals, like those of the Food Conference, indicate a clearer understanding of the continuity of war and peace. All such schemes imply the retention for some time after the War of controls over food, raw materials and transport, as well as some of the national rationing schemes. The organization of common action for peace as for war must be based on the pooling of available resources and a common policy, and a common control to govern their distribution. It should be the business of every citizen of goodwill to promote that understanding, and the Food Conference and the relief agreement supply abundant material for that work—a task which admittedly the British and American Governments should themselves undertake with more vigour and less diffidence than they have hitherto shown.

A third encouraging sign is not merely the shift in emphasis from the political and constitutional to the social and economic factors in post-war reconstruction, but also the attempt to work out the implications of this shift in emphasis on an international scale. These attempts to provide for the immediate needs of food, medical supplies and clothing, and then for the reconstitution of the economic life of Europe in a way offering means of livelihood to its peoples for the future, are far more urgent and far more hopeful than the fixing of frontiers, establishment or re-establishment of constitution and conclusion of international pacts which preoccupied the peace-makers at Versailles. The functional and strictly practical character of the organizations now being set up by the United Nations as the framework of their continued co-operation after the War encourages the hope that the lessons of the past are being learned. If further, profiting again by the failure in 1918 to use such tried machinery as the Allied Transport Council and Food Council, we turn to our post-war purposes such organizations as the various Combined Boards for Food, Shipping, Production and Raw Materials, and the regional organizations such as the Middle East Supply Centre, there should be every reason for confidence that, with the help of all this experience and this established machinery for advice and execution, it should be possible to gain time for the creation and growth of new loyalties and combinations of interest, in addition to national ties. Such an outlook will be of immense importance when the time comes for the establishment of new internationa organizations endowed with full authority to dea with problems of health, food and agriculture, which can only be effectively handled over areas transcending national frontiers. Large as may be the responsibilities of the world's Governments, there still lies on each citizen the responsibility of endeavouring to understand the implications of the situation and of assisting his fellows to grasp it. By these means full support may be obtained for necessary action, even if it may appear to threaten sectional or even narrowly national interests. This is not to suggest that love of one's country is a thing of the past. There is still room for patriotism, but there must in addition be love of humanity; one can surely be built up on the well-tried foundations of the other, to provide an edifice in which there is safe lodging for world understanding and peace.

EDUCATION: FOR WHOM AND FOR WHAT?

SOME time ago a document which, rather inaccurately, became known as the Board of Education's "Green Book", was issued in order that ideas on the future shape of Great Britain's educational system might be discussed and clarified. Copies were not, for what seem to have been quite sound reasons, to be obtained by any save selected bodies. Almost inevitably, however, it appears to have become the most widely known 'secret' document of modern times. The result, nevertheless, has justified its preparation and circulation: for, ever since its issue, all kinds of bodies have embodied their own suggestions in pamphlets of varying hues. The National Union of Teachers was one of those bodies, and, more than a year ago, published its own "Green Book" under the title of "Educational Reconstruction".

The difficulty with all these documents, however, is that they are couched in the language—or is it the jargon?—which the expert tends to use when talking to other experts. Dipping at random among the pages we may find a sentence like this: "In the interim we recommend that the principles of the present Grant Formula, which is a combination of a per capita and percentage grant, be continued". That is, doubtless, an excellent recommendation, and its effect, if it be accepted, may profoundly influence the education and prospects of thousands of students. But it is very doubtful whether it will stimulate any great interest or excitement in the breasts of the majority of parents who want improvements in the educational opportunities of their children but know little or nothing of the intricacies of the system which should produce those opportunities.

Clearly, if educational reconstruction is to be successful, parents must know what it is all about and be anxious to see it put into operation. They cannot do that unless the matter be explained to them in simpler and less technical terms than are normally used by teachers and administrators.

For that reason we believe a new pamphlet issued by the National Union of Teachers meets a very definite need. Its main title is "A Plan for Education"; but it also has a sub-title which gets right to the heart of the matter: "The National Union of Teachers discusses with parents the Kind of Education they want for their children and how to get it".

The pamphlet explains that, since we are fighting for the democratic way of life, it is imperative that, in the very midst of the battle, we should plan such post-war conditions as will enable us to reap the fruits of victory. There are numerous aspects of the general plan now being prepared, but its base must be the provision of a good education.

What, however, is this 'good education' which all parents would like their children to have? The pamphlet answers the question not in a learned discourse but in simple sentences which he who runs may read. "There are few of us," concludes one paragraph, "who do not constantly feel a sense of our own limitation in the enjoyment of life and in the power to seize interesting opportunities when they come our way. We feel we are only half-educated." That is the kind of approach which ought to be successful because it says plainly what so many thousands of inarticulate people feel vaguely but never attempt to express.

In the same simple language this notion of a good education is amplified. The importance of physical as well as mental growth is brought out. "If you are not a hundred per cent fit and healthy, you can't enjoy life to the full." From that point of view the importance of nursery education, school buildings, the school medical and the welfare services are fitted to the picture.

Mental growth is obviously more difficult to assess, but the pamphlet goes on to explain why it is so often retarded. To that end causes in the present educational system which result in failures who ought never to be failures are indicated. Finally, the part played by inequality of opportunity is vigorously discussed. "Some children are taught in splendid buildings, others in disgraceful buildings; some in large classes, others in small; some stay at school until 18, others must leave at 14; some have the chance . . . of going to the university or technical college, others must work at uninteresting jobs . . . and feel defrauded all the rest of their lives."

But the matter is not allowed to rest there. The parents to whom the pamphlet is addressed are told that it is no use always blaming someone else for these shortcomings. If they want this "good education" for their children they must try intelligently to secure it. The job, they are told, comes back to them. "Not 'theirs', 'ours', is the task of seeing that the boys and girls of this generation have an education worthy of the democratic ideal for which their fathers are fighting."

If after so plain a statement, ordinary men and women who read the pamphlet still fail to turn their opportunities to account, the fault at any rate will not rest with those responsible for this pamphlet.

A STUDY OF THE ROBIN

The Life of the Robin

By David Lack. (Bird-Lovers' Manuals.) Pp. 200+6 plates. (London: H. F. and G. Witherby, Ltd., 1943.) 7*s*. 6*d*. net.

ORNITHOLOGY has made notable contributions to general biology during the present century. The student of species-formation, of adaptation, of animal population, of ecology, of behaviour, or of courtship and sexual selection cannot neglect the ornithological literature, for it is there that he is likely to find many of his clearest and best worked out examples. Field-work has been as important as museum or laboratory study, and the contributions of British field-workers have been among the most important.

Lack's book on the robin is in the best traditions of modern British ornithology. It is the result of intensive field observation, backed by scientific method and combined with experiment, and once again demonstrates how much of value there is to learn about our most familiar wild species.

He definitely explodes the myth that the parent robin fights with its young, and finally demonstrates that the elaborate posturing, so often described as courtship display, is found in both sexes, and is entirely concerned with aggressive threat towards intruders. He makes the interesting suggestion that the recrudescence of full song found in the robin and many other species, just after the young have left the nest but are still under parental care, is an adaptation to teach the young birds the proper song of the species. This suggestion could be checked by discovering whether this recrudescence of song is absent in species where the song does not have to be learnt in whole or in part, but is wholly innate.

His study of courtship in the robin has led him to an interesting extension of the idea first thrown out by the present reviewer thirty years ago, that the main biological function of certain types of courtship (for example, mutual display in grebes) lies in their providing an emotional bond between the pair. Lack is now inclined to think that courtship feeding, wherever it occurs, has a bond-forming function, as opposed to the stimulative function of display and certain symbolic actions. One is tempted to generalize this still further and to suggest that bond-forming courtship is likely to occur, in addition to stimulative courtship, in all or most bird species in which the co-operation of the pair is needed to rear the brood.

Lack's ringing methods have established that the British robin is partly migratory, and he suggests that it is in process of transition from a migratory to a non-migratory status. Extending the work of American ornithologists with stuffed mounts, he has shown that, although a robin is capable of extraordinary visual discrimination, such as the recognition of its mate at a considerable distance, yet its aggressive behaviour, normally directed against intruders on its territory, is elicited by the crude "signal" constituted by the red breast. While a stuffed adult whose red breast had been painted a dull brown failed to elicit attack, an isolated red breast, "sans head, sans wings, sans tail, sans everything", was attacked in fifty per cent of the trials. Like other intensive field-studies, but perhaps with special force, Lack's has demonstrated the extent of variability in temperament and behaviour: this constitutes an important section of the reservoir of evolutionary plasticity which is required if a species is to be able to meet changes in environmental conditions.

Some of Lack's difficulties over the theoretical interpretation of bird behaviour are perhaps exaggerated. The reviewer, for example, fails to see why repeated and intensified display should not be expected to act as a more efficient stimulus to an unresponsive mate (p. 72); or why a "drive" should not be as readily produced by natural selection as any other adaptation of functional organization (p. 171). But these are trivial points. Lack's book can be warmly commended not only to the general biologist but also to the layman interested either in birds or in biology. It is well illustrated, fully documented, interspersed with delightful titbits of historical information, and discusses many of the particular problems raised by the robin's behaviour in the light of a wide knowledge of the ornithological literature. It is eminently scientific, and also very readable. JULIAN HUXLEY.

GEM TESTING

Gem Testing for Jewellers

By B. W. Anderson. Pp. 220. (London: Heywood and Co., Ltd., 1942.) 7*s*. 6*d*. net.

As its author remarks in the preface, this book "has been written mainly with the ordinary jeweller and dealer in view". It is, indeed, a praiseworthy attempt to give the otherwise unaided layman a working knowledge of the physical methods and instruments commonly employed in gem testing and also to provide him with the necessary data on which to base his identifications. Mr. Anderson brings to the task a wide experience in gem testing, gemmological teaching and research, and jewellers are indebted to him for making available to them so much of his knowledge of precious stones in a readily assimilable form. There is much useful information for anyone interested in gem-stones, and the book is deserving of a wider public than its title suggests.

The twenty-three short chapters fall into two sections. In the first of these the necessary instruments and methods are described in simple but clear language and with sufficient detail to enable the novice to master them without other assistance. Refractometers, dichroscopes and colour filters, specific gravity methods, microscopes and spectroscopes are discussed, and advice is given on the purchase of suitable equipment. A chapter on the detection of synthetic stones is included in this section.

The remaining chapters deal with the identification of gem-stones and other gem materials. In each case the specific characteristics of the material under consideration are discussed, then the methods for their determination, those involving the minimum of apparatus being given first. Finally, possible imitations and other gems with which that under discussion may be confused are examined. At the end of each chapter is a useful table listing the properties of the group just considered. That his method of treatment amounts to a classification based on colour is recognized by the author, who discusses its defects in some detail. While some will certainly dissent, the reviewer is inclined to agree with the author in thinking that the end justifies the means. Those who disagree will appreciate an alphabetical summary of gem species provided in the appendix, which also contains a glossary, notes on the crystal systems, a list of useful books with brief reviews and specific gravity and refractive index tables.

Of the forty-three illustrations, about half are photomicrographs of inclusions and other internal and surface features of natural and synthetic stones. These give a very clear idea of the phenomena and form a valuable adjunct to the text.

A very full index (about 700 items) adds considerably to the usefulness of the book, which is in bold, clear type on good-quality paper and, with the exception of the 23-page advertisement supplement, is a pleasing production.

THE FIRST STAGE FROM BARBARISM

The Making of Modern New Guinea

With Special Reference to Culture Contact in the Mandated Territory. By Stephen Winsor Reed. (Memoirs of the American Philosophical Society, Vol. 18.) (Issued in co-operation with the International Secretariat, Institute of Pacific Relations.) Pp. xix+326. (Philadelphia: American Philosophical Society, 1943.)

PUBLICATION of this report has been delayed through the outbreak of war with Japan. The research was carried out in 1936 on behalf of the Institute of Pacific Relations, the object being to discover the effects of contact with Europeans upon native cultures in the Mandated Territory of New Guinea. A previous report in 1928 dealt with proposed methods of carrying out the administrative policy towards the primitive Papuan tribes; the present inquiry is on the actual changes attributable to the influence of Europeans.

Beginning with the landing of early explorers, foreign influences are carefully traced to the present day by references to the abundant literature on New Guinea. More than half the volume consists of this interesting and valuable material from records of pioneers, travellers, traders, miners, squatters, missionaries, government officials, etc., both before and after the Germans assumed rights over the Territory, and finally under the administration of the Australian Commonwealth.

In order to gain first-hand experience of native cultures, the author accompanied an American anthropologist, Dr. J. W. M. Whiting, to the Upper Sepik and studied a mountain tribe, the Kwona, for six months. Later, three months were spent in observing the lives of natives who were in direct contact with white men.

Chapter 7 concerns the very difficult and controversial questions of the reaction of the Papuan to white man's culture.

The author has not made it sufficiently clear at the outset whether he considers the ultimate aim of the Commonwealth should be the welding of Papuans and Europeans into a corporate community, or the administration of a plural society without any social unit interfering unduly with another. It depends upon which view is taken as to how far the Australian Government is supposed to have fallen short of its ideal.

As a paternal Government putting the rights of the Papuans before all else, the author admits that the Government has undoubtedly made great efforts in the face of many difficulties, but he is of the opinion that the form of education given to the natives is not calculated to prepare them for independence or self-government, which should be the aim of all democratic governments. He considers also that the superiority of Europeans ought not to be so strongly emphasized as in the relative positions of master and subordinate, and he does not agree with the Australian insistence upon a colour-bar.

This personal attitude is observable in the author's approach to problems in the latter part of the report, where he describes the sophisticated native and his adaptation to new conditions in a general survey of the semi-civilized population of employees, dependent upon many introduced commodities and living in close contact with Europeans.

The volume is valuable as a contribution of material from all sources to form a basis for the inquiry, but it is uncertain that the inquiry has actually been answered. For where such delicate problems as changes in innate cultural beliefs are in question a far more critical investigation of factors seems to be necessary, as well as an anthropological approach to these subjects. Further, information obtained through the clumsy linguistic medium of pidgin-English needs to be very carefully checked on any occasion, but particularly in matters which the Papuan has difficulty in expressing even in his native tongue.

There are slight errors. On p. 82 it is stated that British annexation of the South-East Territory followed the German, but actually the reverse is the case. On p. 260 a paper relating to castes is quoted, but this was written upon the natives of the Solomon Islands and not those of New Guinea, among which those castes do not exist.

P. 29, "fermented drinks are completely absent in New Guinea" ; also in the footnote—the only mention of kava is from the Admiralty Group. Wollaston recorded that the fermented sap of the sugar palm (*Arenga saccharifera*) was being drunk by natives in the South Division, Netherlands New Guinea ("Pygmies and Papuans", 1912, chapter 8). Kava is made in the Western Division, Papua ("Handbook of the Pacific Islands", 1921).

L. EVELYN CHEESMAN.

SHORTENED PHYSICS

(1) Mechanical Physics

By Prof. Herbert Dingle. (Nelson's Aeroscience Manuals.) Pp. 248. (London and Edinburgh: Thomas Nelson and Sons, Ltd., 1942.) 5*s*. net.

(2) Sub-Atomic Physics

By Prof. Herbert Dingle. (Nelson's Aeroscience Manuals.) Pp. 272. (London and Edinburgh: Thomas Nelson and Sons, Ltd., 1942.) 5*s*. net.

(3) University Physics

By Dr. F. C. Champion. Part 5: Electricity and Magnetism. Pp. vii+246. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1942.) 7*s*. 6*d*. net.

PROF. DINGLE'S two small books form a balanced course of physics, not including mechanics. They begin at the post-matriculation stage, assuming a slight knowledge of mechanics and of the calculus, and they attain a level, on the standard of the University of London, somewhere between the physics of Intermediate Science and that of the General B.Sc. They treat ordinary academic physics and are not specially "aero". The explanations are easily read and almost all very clear, the diagrams abundant and satisfactory, the paper good, the print excellent, and the price low. There are indexes and exercises. A welcome addition to the usual course of physics is a chapter on sidereal and solar time, with diagrams of the celestial sphere. An original feature is the broad grouping of the subject-matter into "mechanical" and "sub-atomic" books; the former including gravitation, elasticity, surface tension, viscosity, heat and sound; whereas the "sub-atomic" book includes optics, electricity and magnetism. In explanation of this arrangement the second book has a chapter on the structure of the atom. But it is placed at the beginning, at a stage where the student cannot yet understand the experimental evidence. This dogmatic chapter may whet the appetite of some students, but discourage others.

In the optical section the focal-length of a converging lens is taken to be negative, contrary to the convention recommended in 1934 by a committee of the Physical Society.

There are a few mistakes which should be rectified before students believe them: It is fused silica, not quartz as stated on **1**, 109, which has a much smaller coefficient of expansion than glass. It is contrary to chemical usage to state, as on **2**, 17, that "the halogens (fluorine, chlorine, etc.) . . . are strong bases". Inside a permanent magnet there is reason to believe that the vector which flows continuously, without reversal at each pole, is the induction, and not, as stated on **2**, 184, the magnetic force. The unit of magnetic intensity is dynes per unit pole, and not simply dynes as stated on **2**, 209.

Dr. Champion's book covers the syllabus in electricity and magnetism of the London General B.Sc. It begins at the amber-and-lodestone level and proceeds rapidly, by using the calculus and by extending from easily understood examples to bold generalizations. The electron is introduced at an early stage as a tentative hypothesis. There are plenty of diagrams, most of them quite simple and clear. But where clarity can only be attained by perspective, or other graphic elaboration, the diagrams are of various quality, and a few are unsatisfactory, namely those of the post-office box, of the attracted disk electrometer and of the cathode ray oscillograph. Engineers as a class set a good example to physicists in the art of drawing apparatus.

The print is good, the paper fair; there is an index; there are exercises at the end of each chapter, and a hundred quantitative problems, followed by hints and answers, towards the end of the book.

Beginners are apt to be bothered by the standard argument about the mechanical force on a charged conductor. Dr. Champion does it with apparent ease (p. 23) by putting a unit charge in a small hole in the conductor. But is this novel argument valid without much fuller analysis? Surely the field inside the hole is far from uniform.

This book will get the student through his examination. But we are often told that one of the chief advantages to be gained from a scientific education is the insight into scientific method, and a critical habit of judging evidence. Books of the present compressed type, such as (1), (2) and especially (3), that have been printed during the paper-shortage for the use of students attending shortened courses, are more likely to form the habit of jumping to conclusions in obedience to some phrase of authority, such as: "Now clearly . . ." Various matters on which the physicists of former generations had serious doubts, which they settled by prolonged experimentation and argument, tend to be presented to the war-time student as if they were intuitively obvious. Of course, the transition from original notebook, through research pamphlet, to text-book must always involve an enormous rejection and much compression. But let us hope that, when conditions are favourable, there may be a return to the style in which more of the romance and discipline of past researches and controversies is retained.

The dogmatism of Dr. Champion's otherwise clear and readable text will be remedied, so far as the mathematical aspect of the subject is concerned, if the student will work through the hundred examples at the end of the book. As for the habit of judging experimental evidence, it is well that the universities insist on laboratory work. L. F. RICHARDSON.

PAPER MILL LABORATORY TECHNIQUE

A Laboratory Handbook of Pulp and Paper Manufacture

Incorporating the fourth edition of Stevens's "Paper Mill Chemist". By Dr. Julius Grant. Pp. viii+320+8 plates. (London: Edward Arnold and Co., 1942.) 28*s*. net.

MUCH of the technique of the paper mill laboratory is specialized and described only in papers distributed throughout an extensive literature: it is therefore useful to have in this single volume short descriptions of the most reliable methods of procedure, and references for those who wish to study any particular subject in detail. Probably because of an attempt to keep down the bulk of the volume, many of these descriptions are unfortunately rather sketchy and it is doubtful whether the mill chemist, approaching a given determination for the first time, could in all cases complete it successfully from the brief instructions given. For the same reason, the text is not very critical, nor does it discuss fully the difficulties which one is apt to encounter in practice; so that in general it conveys the impression that the determinations are easier to carry out than they really are. This book, then, should be regarded not as a substitute for a library, nor as a collection of instructions to be followed blindly on all occasions, but rather as a guide to methods and a pointer to sources of information.

In the first chapter, Dr. Julius Grant describes how the scientific worker in a paper mill has to have a good working knowledge of general chemistry, physics and chemical engineering, combined with a personality capable of winning and retaining the respect and confidence of the mill operatives. He has three main tasks. First, he has to examine thoroughly all new raw materials, and check deliveries from usual sources; unsatisfactory batches must not be allowed to reach the mill, and he will be expected to advise on the best way of utilizing materials which, though not up to standard, are nevertheless still usable. Secondly, he has to check the various stages of manufacture in order to guide the operatives in their work and ascertain whether the processes have been carried out efficiently. The third part of his duties is to examine customers complaints; and, where time and resources permit to conduct original research on paper problems Certainly a wide field.

The second chapter deals with the processes of isolating reasonably pure cellulose fibres from the raw materials, with sections on 'cooking', bleaching and the evaluation of cellulose, lignin, etc. Non-fibrous raw materials, such as lime and caustic soda, and the recovery of spent liquors, are discussed in the next chapter. Chapter 4 deals with the preparation and examination of standard test sheets made from the 'half-stuff' and the determination of its 'freeness', moisture content, etc. In Chapter 5, the various operations which take place in the beater house are considered, with special reference to the effect of beating, loading, sizing and colouring on the properties of the resulting paper. The final stages in the conversion to paper are described in Chapter 6. Here are sections on the care of the machine wire, drying cylinders and felts, and the examination of 'backwater'. The 'after-processes' considered include calendering, tub sizing, 'conditioning', coating, waxing and gumming. Paper testing by physical methods is described in Chapter 7. The importance of proper sampling and testing at a definite relative humidity and temperature is stressed, and most of the current tests for thickness, strength, colour, gloss, etc., are outlined. Testing by chemical and microscopical means is dealt with in the next chapter, which includes sections on loading and pigments, ash, acidity and *p*H, metals and acid radicals, cellulose and mechanical wood content, resins, and starch. The main microscopical tests are for fibre identification and furnish, and the determination and identification of dirt particles. The last chapter deals with tests for papers for special purposes, and contains short sections on statistical analysis of data and testing of water and fuel. A number of useful tables are contained in an appendix.

The text is clearly written apart from a few loosely constructed sentences, and there are a few grammatical errors: for example, "to 50 ml. of this *are* added sufficient ammonia" (p. 45); "papers which must *lay* flat" (p. 164). How far the use of numerals in text matter is permissible is always difficult to decide, but contractions like "between 2 rolls", "into 3 main categories" (p. 174) are surely unnecessary and ugly, except in abstracts. What few misprints there are seem to occur mainly among the numerals. The mean wave-length of white light is not 0·05 μ (p. 117); for a "narrow spectral range" 10 A., and not 1000 A., is intended (p. 204); and the "160 mm. objective" on p. 246 should read "16 mm. objective". It is unnecessary to give the viscosity of glycerol as 871.700 centipoises (p. 84) when it is to be used for calibrating a simple flow viscometer; three significant figures would have been ample.

The make-up of the volume is good, except in a few places. For example, Fig. 22, referred to on p. 194, is not inserted until facing p. 258, and the reader is given no indication where it may be found. With the general reservation that the book tends to suffer from over-condensation, it can be recommended. One hopes that the day is not far distant when it will again be possible to test butchers' wrapping paper (p. 272) with "slices of beef liver (2×4×0·5 in.)"! V. G. W. HARRISON.

SCIENCE IN SOUTH-WEST CHINA

I. THE PHYSICO-CHEMICAL SCIENCES

By DR. JOSEPH NEEDHAM, F.R.S.

British Council Cultural Scientific Mission in China

OWING to the course of the War and world conditions, Free China has now been isolated from the rest of the world for such a long time that an account of what our Chinese scientific colleagues have been doing will surely be of interest to readers of NATURE both in Britain and the United States. During the past few weeks, since my arrival, I have had excellent opportunities of seeing the work of Chinese men of science in all branches of their work, and the present opportunity of presenting a short account of it to the scientific workers of the other United Nations is an important one.

Kunming, the capital of Yunnan province, is an ancient Chinese city lying at the northern end of an extensive lake, in a large plain surrounded by mountains. The whole region, with its equable and sunny climate, both winter and summer, must be one of the most beautiful in the world, since the plain is not so large that the mountains are ever out of sight. An intensive agriculture is carried on, aided by an elaborate system of dykes and canals, their banks often raised high above the surrounding fields, and planted with pine-trees, conveying water from the mountain-sides, and dating from the Yuen Dynasty (about A.D. 1200). The scientific institutions are well scattered at different distances from the city, and transport is by horse-cart, charcoal-burning bus, 'jeep', lorry or car.

The National Associated South-Western University

The National Associated South-Western University (Hsi-nan Lien-ho Ta-Shioh), formed by a coalescence of Peiping, Chinghua and Nankai Universities, and perhaps the greatest teaching centre in Free China, has a campus not far from the city. President Mei Yi-Chi (the physicist) attends to internal and local affairs and President Chiang Mon-Lin (educationist) attends to outside affairs. Both are outstanding personalities, embodying the ideal of the Chinese scholar. All the departments are housed in 'hutments' built of mud brick, and roofed very simply with tiles or tin sheets, though some have curving roofs in the great tradition of Chinese architecture. Inside, the floors are beaten earth, with a little cement, and extreme ingenuity has been used in fitting up laboratories for research and teaching under these conditions. For example, since no gas is available, all the heating has to be done with electricity, and hence when the supply of element wire for heaters (home-made out of clay) ran out some time ago, work was at a standstill until it was found that gun lathe shavings from one of the Yunnan arsenals would do very well. When hæmatoxylin became unobtainable, it was found that a dye something very like it could be obtained from an orange-coloured wood native to Yunnan, *Cæsalpinia sappan*. When microscope slides could not be had, window-panes broken by air raids were cut up, and the unobtainable cover-slips were replaced by local mica. For glass-blowing, the blowpipes are fed with the vapour of power alcohol (derived from molasses) passed through electric furnaces. Instances could be multiplied at length.

The campus of the University lies in scenery somewhat resembling Upper Deeside, with its pine-trees and hills in the distance. There are no air-raid shelters, and the population scatters to the hills if a raid looks like being serious. Built into the floors of each mud-brick building are large petrol drums, and all the most valuable apparatus is lowered into these when the siren goes, in order to preserve it against anything but a direct hit. Even in its humble buildings, the Associated University has been bombed several times and many of the rows of huts destroyed.

In the Physics Department of the University (visited with Dr. Wu Yo-Hsün, dean of the Faculty of Science) the main research going on is on the distribution and other properties of cosmic rays, by Drs. Chao Chung-Yao and Ch'ang Wên-Yü (both from the Cavendish Laboratory, Cambridge). But as might be expected under present difficult conditions, more theoretical work is proceeding, and Dr. Wu Ta-Yo recently published an important book on the vibrational spectra of molecules, which was printed just before the fall of Shanghai, and a copy of which has been sent to the Cavendish Laboratory. Radio physics problems are being studied by Ma Se-Chun and Ma Ta-Yo, and mathematical physics, thermodynamics, etc., by Wang Ch'u-Hsi (a pupil of Sir Ralph Fowler) and Huang Tzu-Ching. Prof. Yao Yu-Tai (dean of the Faculty of Science at Peiping University) and Prof. Hsiung Ching-Lai had as their pupil the eminent young mathematician, Hua Lo-Kung, a collaborator of Prof. G. H. Hardy.

The chemical side is mainly directed by Profs. Yang Shih-Hsien and Tsêng Chao-Lun, both organic chemists. One of the principal problems is the investigation of the alkaloids and glucosides in the anti-malarial drugs of the classical Chinese pharmacopœia; this is of much importance in relation to the existing world quinine shortage. There is also a group working with Dr. Ch'u Rju-Hua at the Peiping Institute; her interest lies in the migration aptitude of groups in phenanthrene pinacol compounds, and in the possible relation of vitamin K to the sulphanilamide drugs. Prof. Tsêng and his collaborators are working on glycol lubricants. Unfortunately, as in all the other chemical laboratories I have seen here, the work is seriously hampered by lack of chemical reagents, and the supply of these seems almost more immediately necessary than the supply of books and periodicals. Chemical engineering is taught by Dr. Hsieh Ming-Shan (a pupil of Sir Alfred Egerton), and among the physical chemists is Chien Jen-Yuen (a pupil of Prof. C. N. Hinshelwood). It was a pleasure to see on the shelves of the working library a complete set of the *Journal of the Chemical Society* and other journals, presented by the University of Oxford.

Not all the research institutes of Peiping, Chinghua and Nankai Universities were absorbed into the United University. Out at Dragon King Pool, about two hours distant from the city, are some of the Chinghua Institutes, notably that of mineralogy and metallurgy (Dr. Wang Tsun-Ming), that of radio physics (Dr. Rjên Chih-Kung), and that of crystal physics (Dr. Yu Shui-Huang, a former collaborator of the Braggs). The first of these co-operates with the Yunnan Geological Survey in assaying the numerous interesting and rich ores newly discovered in the province, and has found new alloys with important thermo-electric properties. The second is occupied with telecommunications, and has complete apparatus for making experimental valves in these rustic surroundings. The third possesses good equipment, all made in Yunnan, such as a Debye-Scherrer powder crystal camera, Laue oscillating camera, etc. The altitude of Kunming (some 6,000 ft. above sea-level) is so high that the spark-gap setting is affected. These institutes have good workshops, but they would have very much better ones if financial support were available to set up and run some of the machines which were saved from the east or smuggled through the Japanese lines after the fall of Peiping and Hankow. There is also a great difficulty for all scientific institutions here, namely, that the university or Government wage for technical assistants is much smaller than what they can earn by going into business in a time of rise in prices which may truly be called gigantic. I shall have more to say on this subject in the following article.

National Academies

Besides the universities in China there are also two national academies: the Chinese National Academy (Chung Yang Yen Chiu Yuan) and the Peiping Academy (Peiping Yen Chiu Yuan). Of the ten research institutes of the former, three are located in the neighbourhood of Kunming, those of astronomy, chemistry and engineering. The astronomical observatory, exiled, alas, from its beautiful buildings on the Purple Mountain near Nanking, is situated a long way out in another direction from Kunming, at Big Tree Village. One of the members of the staff there is Dr. Tai Wên-Sai of Cambridge, formerly a collaborator of Prof. F. J. M. Stratton. The chemical institute is nearer town, and work is going on there on ultra-violet spectral analysis of organic and inorganic compounds, as well as on the active principles of local drugs, under the direction of Dr. Wu Shioh-Chou. The engineering institute is largely occupied with glass technology and metallurgical problems. Its workshop constructs all kinds of apparatus, such as kymographs and respirometers, for other scientific institutions.

The physics and chemistry sections of the Peiping Academy are located some three hours out, again in another direction, at a beautiful spot in the foothills near White Jade Hill. Here the physics section, under the direction of Dr. Ni Chi-Sse and Dr. Tsien Ling-Chao, has turned over almost wholly to war production, and a most remarkable plant for grinding lenses for microscopes, telescopes, etc., has been set up. The Academy is actually producing microscopes for teaching and research, having worked out all its own necessary apparatus, such as spherometers, etc. It is dependent on optical glass from England, however. Besides this, entirely new methods have been developed for making quartz piezo-electric crystals for frequency stabilization in radio work, and these are being produced in regular quantity, so that a supply may be available for the other United Nations. A point of interest here is that Dr. Tsien Ling-Chao has worked on the history of science in China, and has studied the optical chapters in the works of the classical Chinese philosopher, Mo-Tze (c. 400 B.C.). The Peiping Academy has also a section of chemistry, presided over by Dr. Liu Wei-Tao. Here also work is proceeding on the indigenous anti-malarial drugs by Dr. Wang Hsiu, an Austrian-trained organic chemist, and on the anthraquinone compounds of the rhubarb family.

Central Machine Works

Together with some of the members of the Peiping Academy, I paid a visit to one of the largest engineering works in China, the (State) Central Machine Works, which is established in a mountain valley in Yunnan, and employs thousands of workers. Here it was a remarkable sight to see the elaborate apparatus for making fine tools, gear wheels, and other engineering parts requiring high accuracy, hidden away from the risk of air bombing in tunnels and artificial caves in the hillside. In the depth of the mountain one could see a Chinese skilled worker checking the accuracy of the machining on a Zeiss universal measuring machine in a constant-temperature room. Or one could view a scene resembling the cavern of Hephæstus, except that the ovens were of the most modern gas-filled kind used for tempering machined steel parts. Elsewhere are a vast foundry and assembling shops. There is an impressive system of apprenticeship, with special shops for training the young fitters and machinists. The main output of the factory is primary machinery such as drilling, planing, milling, boring and rolling machines, which are supplied to arsenals and other works, and the finished products, standing in their rows, were very impressive. These works really deserve an article to themselves. The whole is under the direction of an engineer (a former physicist), Dr. Wang Shou-Chin. Dr. Wang's father, Dr. Wang Chi-Tong, now a venerable figure of seventy, is also interesting. Himself the son of a Hanlin scholar, he was one of China's first modern engineers, and is now in his retirement devoting himself to the study of Buddhism in relation to modern thought.

Description of the Central Machine Works affords an opportunity for mentioning one very hopeful sign observable there, namely, the effort on the part of the Chinese to get away from the bad side of their old traditions of scholarly aloofness from manual labour, and the old system of excessive politeness. In these works, fully trained university graduates in engineering are working side by side with the ordinary workers, taking active day-to-day charge of each special process and controlling every stage. This is really a change from the old graduate's attitude to practical work. The same improvement may be seen in the atmosphere at the National Vaccine Production Institute (the National Epidemics Prevention Bureau), directed by Dr. T'ang Fei-Fên. Here once a week, as a kind of communal exercise, all the workers of the Institute, including the medical men, bacteriologists, etc., as well as the glass-makers, the routine fillers and samplers, the stables staff, etc., join together in levelling and improving the site so as to convert it into a healthy garden.

Geology

It only remains to describe a little of the work of the geologists. The geologists of the Associated University (led by Profs. Sun Yuing-Ch'u, a former collaborator of Prof. J. E. Marr at Cambridge, and Yuan Fu-Li) work in close association with the Yunnan Geological and Mineralogical Survey, and together they have investigated large parts of the province. A picturesque old house in the country has been appropriated to the purposes of a museum, and there a very fine collection has been assembled, with separate sections for stratigraphy, ores, palæontology, etc. Yunnan is an area extremely rich in mineral resources, having admirable ores of antimony, arsenic, zinc, copper, iron, cobalt, tungsten and tin, as well as coal, lignite, rocksalt, asbestos and mica. Phosphate deposits are widespread, with phosphorus content as high as 38 per cent.

THE LISTER INSTITUTE OF PREVENTIVE MEDICINE

FIFTY YEARS RESEARCH ACTIVITY

By SIR JOHN LEDINGHAM, C.M.G., F.R.S.

THOUGH the British Institute of Preventive Medicine had received its certificate of incorporation under the Companies' Acts in 1891, it was not until two years later that its amalgamation with the College of State Medicine, with its rooms at 101 Great Russell Street, London, made possible its embarking on the scientific activities it was founded to promote. It is fitting, therefore, that short of celebrating in some more overt fashion, had times been normal, the jubilee of an institution which has well and worthily performed the charge committed to it by its founders, we should at least take the opportunity of recalling its genesis and of reviewing in briefest compass the services it has rendered to preventive medicine throughout a period which has witnessed that branch of science so bountifully enriched by the cultivation of all those basic studies that minister to its advancement.

The genesis of the British Institute of Preventive Medicine is soon told. A Mansion House meeting took place on July 1, 1889, to discuss the urgent problem of hydrophobia in Great Britain in the light of Pasteur's experimental work, and his elaboration of what had been almost universally hailed as a successful method of treating the victims of rabid dogs by immunizing them with his attenuated virus. At this meeting a resolution moved by Victor Horsley that the Government should be invited to introduce a Bill for the simultaneous muzzling of all dogs throughout the British Isles and for enforcing quarantine of imported animals was carried, and a son of Pasteur who attended the meeting was asked to convey to his father the thanks of the meeting for his services to British victims sent to Paris to undergo the new treatment. A committee was appointed to consider the most appropriate manner of discharging their debt to Pasteur and his staff for treating gratuitously "over 200 of our fellowcountrymen". Towards this object an appeal for funds was made, and the result was a gift of some two thousand pounds which was forwarded to Pasteur as a contribution to the Institute which bore his name and which had been formally opened only nine months previously (November 18, 1888). Funds were also raised towards the reimbursement to needy patients of their travel costs to Paris.

This was not all, however. The Committee enlarged its numbers and proceeded to consider how the lack of an institute in Great Britain with similar objectives to those of the Pasteur could be made good; and the final outcome of their deliberations, details of which cannot be given here, was the founding of the British Institute of Preventive Medicine, which received its charter on July 25, 1891. Long before this date, however, steps had been taken to secure sufficient funds to enable a commencement, even in a small way, of the Institute's programme of work. Financial support was solicited from private individuals and City of London companies, but progress was slow and indeed gave the promoters much concern, for provision had to be made not only for a scientific staff but also for the erection of a building worthy of the purpose it was destined to subserve.

Very substantial help came from the Berridge Trust and the Grocers' Company and this, together with private donations and the liquid assets of the College of State Medicine, with which amalgamation was effected in 1893, placed the British Institute of Preventive Medicine in command of invested funds of the order of £60,000, at least half of which was earmarked for building purposes. Temporary accommodation for staff and students was found in rooms at 101 Great Russell Street, the lease of which was taken over from the College of State Medicine, and here the work of the Institute was carried on under very restricted conditions until the move could be made in 1898 to the new building in Chelsea Gardens. On December 6 of that year the British Institute became the Jenner Institute, in fulfilment of a promise by the Council to the Jenner Memorial Committee, which had collected funds to commemorate in some fitting way the centenary of Jenner's great discovery, that such change would be made should the funds collected be placed at the disposal of the Institute. The sum handed over by the Committee amounted to £5,768 and, ever since, the revenue from its investment has been disbursed on behalf of a Jenner Memorial Studentship tenable at the Institute. Five years later, in 1903, constantly recurring difficulties arising from a prior claim to Jenner's name by a body trading as the Jenner Institute of Calf Lymph, necessitated a further change of name and it was decided, with Lister's consent, that the Institute should bear his name.

Since the Mansion House meeting, Lister had taken a leading part with Sir Henry Roscoe in all the difficult and tedious negotiations with Government departments leading to the incorporation of the Institute as an association limited by guarantee but permitted to omit the word "Limited" from its designation. He had publicly upheld the importance of animal experiment in opposition to the noisy objections of the anti-vivisectionists, and he had been president of the Council of the British Institute until that body ceased to exercise executive functions on its replacement by a governing body of seven members under the terms of the munificent gift (1899) of £250,000 to the Institute by Lord Iveagh, whose interest Lister had been largely instrumental in securing. This gift gave an immediate assured income of some £8,000 a year and made possible progress in many directions.

So far I have referred only to the main research building in Chelsea Gardens, but one of the earliest ventures was the organization by the Council of the British Institute of an experimental farm for serum production, particularly diphtheria antitoxin. Dr. M. Armand Ruffer, who was appointed interim director in 1894 after the amalgamation with the College of State Medicine, was able to report to his Council that in August of that year he had immunized one or two horses against diphtheria toxin. These first horses to be immunized in Great Britain were stabled at the Brown Institution, and valuable help with the technical arrangements was given on the spot by Horsley and Sherrington. Later in the year, the work was removed to Sudbury, and finally in 1902 transferred to Elstree, where the Serum Department of the Institute has since been located. This department has not only been of enormous value to the Institute in providing an additional source of income from the sale of biological products, particularly therapeutic sera, but has also proved an unequalled training ground for young members of staff and voluntary workers, native and foreign, eager to acquire a practical knowledge of immunological principles with the added advantage of working with large animals.

Further Developments

Developments of the Lister Institute since its inception have been concerned almost solely with the growth of departments, and the institution of new departments rendered desirable less by reason of completeness or mere yielding to custom, than by the availability of outstanding exponents to run them. Some departments have had short lives, while others, such as those of nutrition and biophysics, the latter a quite recent innovation, have obviously come to stay in view of their weighty contributions to preventive medicine in the widest sense. It may be of interest to note that in 1919 the Governing Body, then becoming anxious about the future financial state of the Institute in view of increased costs of research and a probable falling-off in trading profits, proposed to the members that the name of the Institute as shown in the articles of association be changed to the "Lister Institute of Medical Research", on the ground that the change would convey to all persons more clearly the nature of the work carried on in the Institute than the words "Preventive Medicine", and that consequently more public support in the form of additions to its permanent revenue might ensue. The motion, however, was lost at an extraordinary general meeting of the members held on June 11, 1919.

The proposal in 1914, by a majority of the Governing Body, to hand over the Institute to the Government, under certain conditions, as a nucleus of the research organization contemplated by the National Health Insurance Act of 1911, created wide interest both internal and external. At a specially called meeting on November 18, 1914, of members of the Institute, Sir Henry Roscoe in the chair, the proposal was keenly debated, the merits and demerits of State control being the main theme expounded by a succession of distinguished speakers. The motion to amalgamate was, however, lost by a narrow margin of votes.

The idea of having a research hospital attached to the Institute, of similar character to those at the Pasteur and Rockefeller Institutes, was *inter alia* considered by a Reconstruction Sub-committee of the Governing Body in 1919, and it was agreed to be a sound one. Steps were accordingly taken with the approval of members at specially called meetings to have the relevant item on treatment in the original memorandum of association altered by the Court to permit the building of an in-patients hospital for which ground adjacent to the Institute was available, provided that, for the establishment and maintenance of such hospital, only funds "as shall be specifically subscribed for that purpose" be employed. So far, the necessary funds for that purpose—and they would require to be very large funds—have not been forthcoming.

The Institute as a Scientific Centre

It is not for me, at least here and now, to traverse, much less to assay, the published work of half a century in a variety of fields. This must await a fuller history. Apart from the two specially printed volumes of dates 1897 and 1899 (London: Macmillan and Co.) containing papers published before the Institute adopted the name of Lister, there have appeared some forty volumes of "Collected Reprints", copies of which have been sent to selected individuals and scientific libraries in Great Britain and abroad. The very titles of the papers in these volumes will, as the years pass, be found to reflect very accurately the kind of problems that have exercised the minds of investigators at different periods, from the earliest activities of bacteriology, chemistry and immunology as the chief handmaidens of preventive medicine, to the advent of other disciplines such as biochemistry and biophysics which have come to the help of, and indeed would sometimes seem to dominate, current advance in fields which hitherto have been cultivated mainly on biological lines. I may mention, for example, bacteriology, immunology, nutritional science, endocrinology and virus structure. It is already clear that future workers in the field of preventive medicine, whatever form their particular biological training may take, will be well advised to add to their armamentarium a good deal more than a mere capacity to appreciate the help that chemistry and biochemistry can give to their problems; *mutatis mutandis*, I may add, for the trained chemist embarking on a biological problem.

Fortunately, in an institute containing experts in various disciplines, the difficulty of ensuring that the fullest light is thrown on a problem is considerably lessened. In the forty-two volumes to which I have alluded appear not only the fruits of inquiries planned within the Institute's walls but also scientific contributions and reports on a great variety of problems in the solution of which Institute workers have from time to time been invited to participate by various Government, public and scientific bodies. I may refer, for example, to such matters as the experimental demonstration of the rat flea as the vector of plague, the new knowledge of caisson disease and cognate issues made possible by the large pressure chamber, the gift of Dr. Ludwig Mond, the work on vitamins and deficiency diseases originally commenced in the middle of the War of 1914–18 to satisfy a crying need for special knowledge to meet an urgent war problem, and now with greatly expanded knowledge serving the present war effort at home and abroad, the investigation of the insect vector question in trypanosomiasis, yellow fever, typhus and trench fevers and many others.

Aside from its research activities, or perhaps because of them, the Institute has from its inception performed a most valuable function in providing research facilities for young workers from Great Britain and other countries desiring to acquire a working knowledge of technical methods, or to undertake under supervision some particular piece of work, holders of Beit and other fellowships, including those attached to the Institute, together with approved young graduates preparing for the higher research degrees of the University of London, with which the Institute has long been affiliated as a research school with its professors, readers and recognized teachers. Many of these former students and many former members of the Institute's staff have afterwards had distinguished scientific careers in academic or other spheres in various parts of the world. Having but recently retired from a lengthy term of service on the Institute's staff, I would wish to send here a friendly greeting to all former Listerians on this important occasion; and to offer, on behalf of NATURE, its congratulations to the Institute's Governing Body and staff, and its best wishes for the future work and welfare of the Institute in a post-war world.

ASCORBIC ACID IN DEHYDRATED FOODS

By DR. L. W. MAPSON

Dunn Nutritional Laboratory, University of Cambridge, and Medical Research Council

THERE is much evidence that titration against 2,6-dichlorophenolindophenol, provided it is done rapidly and in acid solution[1], gives results accurately agreeing with the biological estimate of ascorbic acid in common foodstuffs, including fruits and vegetables (both raw and as generally cooked), and in various animal tissues[2]. Even for most manufactured articles, such as jams, tinned fruits and various other processed foods, the chemical test has been shown to be generally applicable[2]. In a few exceptional instances, however, interferences from non-specific reductants may have to be allowed for. Such substances occur in caramelized and fermented products (for example, in malt extracts, or the products obtained by alkaline-heat treatment of sugars, in materials such as oats or pea mush after heat treatment, and in yeast and fermented juices)[3]. The substances known to interfere include stannous and ferrous salts, as well as sulphites, sulphides and thiosulphates, among inorganic substances, and reductones and reductic acid among organic compounds. Substances of the former class, however, are not normally present in foodstuffs, and moreover they can be fairly easily differentiated if desired. Thus, thiosulphate and sulphydryl compounds may be removed by precipitation with mercuric acetate[4], sulphite by treatment with acetone[5], or sulphides by conversion to hydrogen sulphide and removal *in vacuo*. Lugg[6] has recently recommended the use of formaldehyde to differentiate ascorbic acid from sulphides, sulphites, thiosulphates, quinones, sulphydryl compounds and reductones. It will be recalled that glutathione does not interfere under the conditions of the test[7], and that free cysteine is not normally a constituent of foodstuffs and in any event reacts so much more slowly that its presence would not be a source of serious error.

We became interested in the differentiation of ascorbic acid from reductones and allied compounds when evidence was found of their presence in certain dehydrated foods which had been subjected to heat treatment. These reductones, as would be expected from their chemical structure, resemble ascorbic acid in many ways ; they are more stable in acid and less stable in alkaline solution ; their oxidation is catalysed by copper and enzymes such as ascorbic acid oxidase ; and they give a current-voltage curve on the polarograph so close to that given by ascorbic acid that, in high concentrations, it is difficult to estimate ascorbic acid in their presence. For this reason, we have examined in detail the possibility of using formaldehyde to differentiate between them and ascorbic acid, and have found that if proper precautions are taken this reagent provides a valuable means of making the titration with 2,6-dichlorophenolindophenol a highly specific method for estimating ascorbic acid in the presence of reductone-like substances. As reliable methods for assaying ascorbic acid in dehydrated foods are of topical interest to an increasing number of workers, a preliminary note on a method so far found successful seemed appropriate.

The method used is as follows. The material to be analysed is extracted with sufficient 5 per cent metaphosphoric acid, according to the method recommended by Harris and Olliver[8], to give an extract containing preferably between 0·04 and 0·10 mgm. of ascorbic acid or its equivalent per ml. If the material to be analysed is too poor a source for this to be done, it should be extracted with the minimum of metaphosphoric acid consistent with adequate extraction. The extract should be kept in the dark during the analytical operations.

If the presence of sulphide, sulphite or sulphydryl compounds is suspected, an aliquot portion of the solution is adjusted to *p*H 0·6 by the addition of 50 per cent H_2SO, then HCHO to a concentration of 4 per cent is added and the solution titrated against indophenol dye after standing for 8 min. at 20° C. If no sulphide, sulphite or SH compounds are present, this preliminary treatment may be omitted and the first step is to titrate the metaphosphoric acid extract (*p*H 1·2) directly against indophenol. In either instance, this titre, expressed as ascorbic acid, is the initial value (A) for plotting graphically at zero time. (Modifications in the initial treatment have to be carried out if the metaphosphoric acid extract contains substances like dihydroxy maleic acid, or reducing compounds present in malt extracts or beet molasses which are unstable in metaphosphoric acid solutions ; for details the reader is referred to the fuller paper in the press.)

A further aliquot of the metaphosphoric acid extract is adjusted to *p*H 2·0 by the addition of sodium citrate solution and HCHO added to a concentration of 8 per cent, and the solution allowed to stand at 20° C. Samples of this solution are withdrawn at intervals of 5–10 min. and immediately brought to a *p*H value of 0·6 by the addition of 50 per cent H_2SO_4 in order to arrest further reaction. These several solutions are titrated against indophenol within 5 min. of taking the sample. It is quicker, and little accuracy is lost, if the samples of solution at *p*H 2·0 mixed with HCHO are titrated directly with indophenol without the addition of H_2SO_4, provided there is no delay and the time interval noted in each instance between the start of the reaction and the moment of titration.

These titrations should be carried out at intervals over a period of 0–90 min. after adding the HCHO, and the values of the indophenol titres, expressed as ascorbic acid, plotted as ordinates, against the times as abscissæ. The line joining the points on the later flat part of the curve so obtained is extrapolated back to the ordinate axis, cutting it at a point X. The difference between the initial indophenol titre A and the value represented by the point X is equivalent to the ascorbic acid content of the extract.

The principle of the procedure is as follows. In the preparatory treatment used in the presence of sulphydryl compounds, the latter are removed by condensation with the formaldehyde but, at the very acid reaction employed, ascorbic acid and reductones remain unaffected. The initial titration A, at *p*H 0·6 or 1·2, measures ascorbic acid plus reductones. In the second reaction, in the less acid solution (*p*H 2), the ascorbic acid is completely removed by condensation, while the reductones are only slowly condensed, and their amount can, therefore, be found by extrapolation in the manner described, the ascorbic acid being given by difference.

The method so applied to fresh vegetable and animal tissues, and some typical cooked foods, jams, canned foods, etc., gives results agreeing well with those obtained by the ordinary, direct indophenol titration, but in the special case of certain dehydrated foods subjected to heat treatment, the ascorbic acid values are found to be lower than those given by the simple titration with indophenol. Although, for example, the ascorbic acid content of freshly dehydrated cabbage, whether determined by direct indophenol titration, by biological test[9], or by the formaldehyde method, is identical, after the dried cabbage has been stored at temperatures in excess of 25° C., there is a gradual production of substances capable of reducing indophenol which resemble reductones in their reaction to formaldehyde. Reductones may also be produced in dehydrated foods if the fresh materials are dried at unduly high temperatures so as to cause even slight scorching of the tissues. For these reasons, it is advisable when estimating ascorbic acid in such materials, or in fermented or caramelized foodstuffs in general, to employ a method which will differentiate between it and reductones, or reductone-like substances. Full experimental details of the method, and an account of the results, will be published shortly.

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APPARENT VITAMIN C IN CERTAIN FOODSTUFFS

By Dr. FRANK WOKES, JOAN G. ORGAN, JEANETTE DUNCAN AND Dr. F. C. JACOBY
'Ovaltine' Research Laboratories, King's Langley

A NUMBER of previous workers[1,2,3] have reported the occurrence of non-specific indophenol-reducing substances in certain fermented or heated foodstuffs. Investigations in our laboratories during the last two years have confirmed these earlier findings and extended them to a wider variety of materials, while showing that the interfering substances may be produced under much less drastic conditions than was previously thought possible. The term 'apparent vitamin C' is suggested as conveniently describing these substances which differ from interfering substances previously studied (such as sulphites, glutathione) in simulating vitamin C so closely in their chemical and physical properties that they cannot be distinguished from it by the assay methods which have so far been generally employed. It is probable that, in contrast with sulphites, glutathione, etc., they also resemble vitamin C closely in chemical constitution.

In 1941, during experiments on the production of vitamin C in germinating grains (wheat, barley and oats) using the dye 2 : 6-dichlorophenolindophenol to estimate ascorbic acid, it was found that the apparent vitamin C content could be considerably increased by heating the germinated grains with water containing 1 or 2 per cent of concentrated hydrochloric acid, dye titration figures becoming steadily larger as heating continued. At *p*H 4·5–5·0 in absence of mineral acid, the production of the apparent vitamin C in extracts of these grains took place equally rapidly at 100° C., and still occurred more slowly at lower temperatures down to 5 or 6° C. Its rate of production is also affected by the moisture content, being almost completely inhibited by reducing this to 1 or 2 per cent. The apparent vitamin C thus obtained resembles ascorbic acid in many of its properties, being rapidly destroyed by oxidase from cabbage leaves or tomato skins, by shaking with charcoal in air and by very low concentrations of hydrogen peroxide (1 in 10^6) or of percarbonate (1 in 10^5), but has not the physiological properties of vitamin C. It has been found in a variety of food products, including fruit syrups, cocoa, malt extract, dehydrated fruits and vegetables and cane and beet molasses; also in a number of samples of beer. Concentrated preparations have been obtained with an apparent vitamin C content of 200–300 mgm. per 100 gm., but no physiological activity as shown by biological tests. Spectroscopic examination of some of these preparations by Dr. R. A. Morton showed absorption maxima at 256–264 mμ, and 275–280 mμ, suggesting the presence of reductic acid first described by Reichstein and Oppenaeur[4] and possibly of dihydroxymaleic acid (*vide* S. Györgyi[5]) or of oxytetronic acid (*vide* Mohler and Lohr[6]). Attempts to extract dye reductants from these concentrated preparations by shaking or heating in a soxhlet with methanol or ethanol or by prolonged shaking of the aqueous extracts with ether have so far failed.

During the last two years we have experimented with various methods of estimating ascorbic acid in the presence of these non-specific dye-reducing substances, based on various properties such as their stability towards heat and instability towards acid in dilute aqueous solution. By such methods we discovered that the development of apparent vitamin C in certain foods during processing involving heat, or during storage, may lead to dye titrations giving false impressions of the vitamin content and its stability. In December 1942, learning from Dr. Mapson that he was working on a similar problem in dehydrated foods, we interchanged results with him, and at his suggestion explored the possibility of estimating true vitamin C in our experimental materials by condensation with formaldehyde as proposed by Lugg[7].

Mapson[8] has investigated the formaldehyde method thoroughly. He obtains the best results at a *p*H of about 2. However, the interfering substances with which he has been mainly working are probably of the nature of reductones such as Norrish and Griffiths[9] obtained by heating various carbohydrates with alkali. Spectroscopic evidence indicates that changes take place in reductones when *p*H is below 6. Our apparent vitamin C, which is produced at a *p*H below 5, and in some instances so low as 1, differs from reductones in being unstable in metaphosphoric acid solutions, and in being more readily distinguished from true vitamin C by condensation with formaldehyde at *p*H 4–5 than at *p*H 2. At *p*H 4–5, formaldehyde reacts with only a small fraction (usually 5–10 per cent) of the interfering substances while destroying the whole of the true ascorbic acid. The total apparent vitamin C in the preparation is first estimated by the potentiometric method of Harris, Mapson and Wang[10], particular care being taken with the precise timing and rate of addition of dye as mentioned by Wokes *et al.*[11]. The true ascorbic acid is then destroyed by six minutes treatment with 6 per cent of formaldehyde at *p*H 4–5 and room temperature, and apparent ascorbic acid again estimated. The difference between the two results, corrected for the small amount of interfering substance which has also condensed with the formaldehyde, indicates the true vitamin C content. In all determinations of apparent vitamin C the metaphosphoric acid extracts should be stabilized with nitrogen as soon as they are made. The above method has given satisfactory results with mixtures of true ascorbic acid with the interfering substances in widely different proportions, duplicates agreeing within the limits of experimental error of the potentiometric method, which we found more suitable for many of our coloured products than the visual method used by Mapson.

Apparent vitamin C has not yet been found in *fresh* fruits and vegetables, although we have reason to believe that it is not entirely absent from the vegetable kingdom. Hochberg, Melnick and Oser[12] have recently reported some interesting findings on *dried* tomatoes and potatoes which we also have been studying. Using a photometric method of estimating vitamin C in which the rate of decolorization of the dye is followed by readings taken every five seconds, they find that on storage there is progressive formation of dye-reducing substances which in visual titrations react slowly, thus giving too high results. They appear to think that this apparent vitamin C which gradually develops may contain dehydroascorbic acid as well as other non-specific dye-reductants. They claim that their method is much more specific for true ascorbic acid, allowing determinations to be made in the presence of relatively large amounts of other substances which reduce the dye. We have followed by means of E.M.F. changes the rate of reaction of true and of apparent vitamin C with the dye in many estimations during the last eighteen months, and agree that the non-specific substances reduce the dye more slowly than ascorbic acid does. In contrast with the above authors, we find the reaction of the dye with ascorbic acid to be completed in less than two seconds, even with much higher concentrations of ascorbic acid than they employed, while the reaction with dihydroxymaleic acid and other constituents of apparent vitamin C may require more than a minute for its completion. We consider this method of estimating true vitamin C in the presence of apparent vitamin C to be less accurate than the formaldehyde method, either used visually as described by Mapson or (when this is not applicable) used potentiometrically as described above.

We are indebted to Dr. L. J. Harris and his colleagues for advice and criticism, to Dr. R. A. Morton for spectroscopic examination of various samples, and to Mr. H. C. Powers, chief chemist, Messrs. Tate and Lyle's Thames Refinery, for samples of molasses.

Details of this investigation will be published elsewhere.

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OBITUARIES

Prof. Charles Schuchert

THE death of Prof. Charles Schuchert, which occurred on November 20, 1942, removes an eminent American stratigrapher and palæogeographer, who was also a leading authority on brachiopods. Born at Cincinnati on July 3, 1858, he was early attracted by the richness in fossils of the rocks surrounding his home; and although he received only a primary school education, which ceased when he was fourteen, he made such good use of his opportunities of collecting that he attracted the attention of the great American palæontologists of the period. In 1885 he was given employment as assistant in palæontology to E. O. Ulrich, and later he worked in turn with James Hall and with C. E. Beecher. He worked in connexion with the Geological Survey of Minnesota, and in 1893 became assistant palæontologist to the United States Geological Survey. In 1894 he was appointed assistant curator in palæontology at the United States National Museum, where he remained for the next ten years, having opportunities during this period to collect in Europe, Greenland and Canada. In 1904, at Yale University, he became concurrently professor of palæontology, professor of historical geology in the Sheffield Scientific School, and curator of the geological collections at the Peabody Museum. He remained at Yale for the rest of his life, receiving the title of professor emeritus on his retirement in 1926, and of director emeritus of the Peabody Museum on his eightieth birthday. He received honours from various universities and learned societies; he was president of the Geological Society of America in 1922, and was elected foreign correspondent of the Geological Society of London in 1927 and foreign fellow in 1929.

Schuchert's published books, papers and articles amounted in all to between two and three hundred items, their subjects including stratigraphy and palæogeography, primarily of America, systematic palæontology, and scientific biography. His interests covered the whole geological column, but he concentrated especially on the Palæozoic. Together first with Pirrson and then with Dunbar, he published "A Text-book of Geology", being himself responsible for the section on historical geology; and in 1927 appeared a book intended for the layman, "The Earth and its Rhythms", written jointly with Clara M. LeVene.

In the field of palæontology, he worked principally on the Brachiopoda, although members of other groups, especially of the Echinodermata, also claimed his attention. About 1902, he presented his collection of fossils, including ten thousand brachiopods, to the United States National Museum, but he made a further collection of some hundred thousand specimens of brachiopods which he bequeathed to Yale.

His knowledge of the brachiopods was wide and deep. He published many papers on their systematics, including in 1932 a monograph of the Orthoidea and Pentameroidea written in collaboration with G. A. Cooper. Perhaps, however, the greatest significance of his work lies in the fact that he was the earliest author to produce a general conspectus of the group following on the pioneer work of Davidson, Hall and Clarke, and the other great 'brachiopodists' of the later nineteenth century. In 1897, Schuchert published "A Synopsis of American Fossil Brachiopoda including Bibliography and Synonymy", which has remained a standard work, containing a sound discussion of the evolution of the group. Later he undertook in Zittel-Eastman's "Text-book of Paleontology" the section on brachiopods, which again is indispensable as a work of reference. In 1929, together with Clara M. LeVene, Schuchert produced the brachiopod section of the "Fossilium Catalogus", an invaluable index of genera and genotypes, newly classified.

Schuchert's combination of detailed knowledge of the brachiopods with a wide and inclusive outlook on palæontology enabled him to recognize systematic differences but yet at the same time to avoid excessive 'splitting', while producing an orderly classification from a chaotic group. The outcome of long-continued thought and consideration, his studies revealed with complementary clarity the nature both of the component individuals and of the group as a whole.

Muriel A. Arber.

We regret to announce the following deaths:

Prof. William M. Esten, emeritus professor o bacteriology in the University of Connecticut, o April 16, aged eighty.

Dr. K. Landsteiner, For.Mem.R.S., of the Rockefeller Institute for Medical Research, on June 26, aged seventy-five.

Prof. Garfield Powell, assistant professor of chemistry in Columbia University, aged forty-nine

Dr. Mary J. Rathbun, honorary associate in zoology of the U.S. National Museum, on April 4, aged eighty-two.

Prof. W. A. Setchell, emeritus professor of botany in the University of California at Berkeley, on April 5, aged seventy-eight.

Prof. William C. Walker, professor of chemistry in McMaster University, Canada, on March 30.

NEWS and VIEWS

Industrial Research in Great Britain

Sir Edward Appleton, secretary of the Department of Scientific and Industrial Research, in opening the new physico-chemical laboratories of the British Coal Utilization Research Association at Coombe Springs on June 23, congratulated the Association both on its new facilities in laboratory space and on the financial provision now available for large-scale work. The steps the Association has taken are among the first notable signs of a great forward movement in industrial research in Great Britain, Sir Edward said, which he confidently expects will be one of the features of post-war Britain. The Coal Utilization Research Association is serving the coal industry as a whole, and he particularly welcomed the expression of the interest of the miners themselves shown in the recent appointment of two members of the Mineworkers' Federation to the council of the Association. It is, he said, fashionable nowadays to decry British industrial research effort, because it is claimed that the amount of money spent on research per head of population is less than that in certain other countries. Much depends, of course, on what basis such a calculation is founded; whether or not, for example, development costs are included under the heading of research. Moreover, there can be unwise expenditure, as well as wise expenditure, even on research. But it can certainly be stated that British effort on research is not commensurate with our industrial needs. To talk merely of spending more money, however, was not enough. It was necessary to plan our attack on both new and old problems and, most important of all, to attract some of our best scientific brains in the country to solve them.

It has also been stated that, whereas Great Britain has, in the past, been responsible for many of the most fundamental discoveries in science, other countries have often been the first to apply them to practical ends. Sir Edward said that he could safely predict that when the full story can be told after the War, our work in the application of science, as distinct from the accumulation of scientific facts, will be found second to none. He instanced the example of one of the most striking of our war-time developments, namely, that of radio-location, which was not, as is commonly supposed, a new invention. Here a technique developed for purely scientific ends has been magnificently applied by young British scientific workers to practical war-time uses. In this and other fields it has been amply demonstrated that the young men of Great Britain can hold their own in bridging the gap between laboratory science and its useful expression in appliances and industrial processes.

National Academy of Peiping

A report of the National Academy of Peiping covering the years 1937–42 has been issued by the Kunming Office of the Academy. On the outbreak of the present war with Japan, Peiping was immediately taken over by the invader, and the Academy, which at its foundation in 1929 consisted of nine separate research institutes with a staff of more than two hundred, succeeded in transferring part of the books and equipment of each of its institutes to the south; within a few months most of its work was resumed at Kunming, Yunnan, with a staff now consisting of 120 members. In addition to Chinese Government grants amounting to 620,000 dollars, grants are received from the Sino-American, Sino-British and Sino-French Foundation Funds. The Institute of Physics has been increasingly concerned with problems of industry and national defence. A laboratory for spectroscopy has been established to meet the needs of the new metallurgical industry, and the Institute has also standardized more than a thousand radio transmitters with its own quartz oscillators. Its other efforts have been confined mainly to the development of applied optics and geophysical prospecting. The Institute of Radium consists of laboratories for chemistry and radioactivity, in which many Chinese minerals have been examined, and for X-rays, where the work has been mainly on crystal analysis and X-ray studies of alloys of tungsten and antimony.

In the Institute of Chemistry, work has been carried out on the extraction of dyes from local plants and their application to textiles, the preparation and small-scale manufacture of medicinals from local raw materials, the recovery of used engine oils, replacement of Diesel oil by vegetable oil and preparation of a substitute for petrol from molasses and sawdust, analysis of water supplies and extraction of potash from different types of ashes. The Institute of

Materia Medica has concentrated on investigations of Chinese drugs, such as Chinese ephedra. The active principles have been isolated, and their properties and pharmacological action studied. Some materials such as ephedrin and vitamin B_1 have been prepared on a commercial scale for clinical use. The Institute of Physiology has extended its investigations on the physiological effects of various Chinese drugs to investigations on the nutrition values of the foodstuffs used by inhabitants of the south-west of China, and the treatment of Chicken cholera with sulphanilamide. The Institute of Zoology, besides work on the fauna of Yunnan, has made systematic studies of the principal freshwater fauna of Yunnan, particularly the fishes of the inland lakes, their diseases and enemies. The Institute of Botany has commenced investigations on economic botany, in addition to those on agriculture and forestry already in progress, and a special survey of the plant life of north-west China has been planned and organized. The Institute of Geology is mainly occupied with the detailed mapping of mineral deposits (see also p. 9 of this issue of NATURE).

Earthquake in Turkey

ON June 20, following foreshocks during the previous night to the accompaniment of torrential rain, a severe earthquake shook the beautiful, rich, fruit-growing district just to the east of the Gulf of Ismid, on either side of the Istanbul-Ankara Railway about sixty miles east of Istanbul. The epicentre of the shock was near, and probably just east of, the town of Adapazar, where most of the buildings were wholly or partly wrecked. Other towns more or less damaged in the district were Geyve, Arefie and Hendick, the latter twenty miles east of Adapazar. Nearly all the villages in the district suffered. The shock was felt severely in Istanbul, where some apprehension was caused by walls collapsing. The Constantine Pillar in old Istanbul, dating from the first half of the fourth century, is reported to have been damaged.

Adapazar is a town of some 20,000 inhabitants, and it is fortunate that most of the people there and in the surrounding districts were out of doors, otherwise the death-roll would have been higher than the present estimate of 2,000. Telephone and rail communication broke down so that full information is not yet available, but it is known that the bulk of the population is now living in tents in the fields and orchards of the district. A strong shock was recorded at Stonyhurst College Observatory, near Blackburn (Rev. J. P. Rowland, *S.J.*), at 15h. 38m. 26s., and another at 17h. 59m. 18s., both probably from the Turkish focus. The shock, therefore, probably took place about 15h. 32·8m. and the aftershock about 17h. 53·7m. Help has been sent to the stricken area from Ismid, Bolu and Istanbul, and further information from the district is awaited. The last serious earthquake in Turkey was some six months ago, though the country, particularly that part to the east of the present disturbance, has never been free from recurrent small shocks since the great Turkish earthquake of December 27, 1939 (NATURE, 145, 13; 1940).

Wellcome Research Institution

FREQUENT inquiries are being received, both from this country and abroad, with regard to the two Wellcome Museums. They are, and will continue to be, housed in the Wellcome Research Institution, 183–193 Euston Road, N.W.1. Although the Wellcome Research Institution building suffered considerable damage by enemy action, its structure was unharmed and the Museums can quickly be put into shape again as soon as labour and materials become available after the War. While some of the objects in the Wellcome Historical Medical Museum were damaged, it has been possible to replace or repair most of them. Fortunately, the specimens and other valuable material in the Wellcome Museum of Medical Science remained comparatively intact.

Both Museums are now under the directorship of Dr. S. H. Daukes. A comprehensive scheme for the Wellcome Historical Medical Museum has been prepared and will be brought to completion as speedily as possible after the cessation of hostilities. The Wellcome Medical Library, comprising more than 150,000 volumes, will also be in the same building, and suitable accommodation will be provided for research workers so that both the library and collections may be readily available. The Wellcome Museum of Medical Science—which in the past has been much used by teachers, students and those engaged in post-graduate studies—will be re-established in its entirety at the end of the War with the utmost possible speed. The large lecture hall will be fully re-equipped, including film projection apparatus, and will then be available for scientific lectures and meetings.

Local Industrial Health Advisory Councils

SHORTAGE of medical personnel makes it impossible to satisfy the need for an industrial health service at all fully at the present time in Great Britain, but in every area there are individuals who have sufficient knowledge and experience to give very material assistance in solving local problems. The workers themselves are beginning to take an active interest in measures to promote safety and health, and in some factories safety and/or health committees have already been set up. One of the difficulties that faces these committees in factories where no medical officer is available is how to obtain professional and technical advice in dealing with their problems. Advice on points to note that are particularly valuable as indications of general health trends can also be well used by interested workers. The Leicester Branch of the Socialist Medical Association has endeavoured to bridge this gap in the following way. First, a meeting of workers' representatives was called and an outline given to them of the problem as seen from the point of view of medical and allied personnel. At this meeting, considerable information was obtained regarding health conditions in local factories, and questionnaires were distributed so that further details might be submitted and collated. A second meeting was then held, this time for health workers—medical men, nurses, social workers, welfare officers, etc.—and the information received in the questionnaires was put before them. Arising out of this meeting, a local industrial health advisory council has been set up, through which it is hoped that specialist advice on industrial health matters will be available wherever it is required. There is also, of course, the Central Council for Health Education (Tavistock House, Tavistock Square, London, W.C.2), which has considerable facilities and offers help and advice on industrial and other health problems.

Astronomy in Ships' Names

A NUMBER of Victory Ships recently launched from the slips of the California Shipbuilding Corporation at Wilmington, California, have been named after astronomers. Ship No. 125 of the corporation's war-time programme, the s.s. *George E. Hale*, was launched on January 19 last after only 27 days on the ways, and commemorates the inventor of the spectroheliograph and spectrohelioscope, founder of the *Astrophysical Journal*, and constructional genius mainly responsible for the design and erection of the world's largest refracting and reflecting telescopes at Yerkes and Mt. Wilson respectively. The s.s. *Maria Mitchell*, vessel No. 147, takes her name from the professor of astronomy at Vassar College, who discovered a comet and who was the first of her sex to be elected a member of the American Academy of Arts and Sciences. Ship No. 158, the s.s. *Simon Newcomb*, launched on March 26, is named after the famous superintendent of the American Nautical Almanac Office, who was commissioned professor of mathematics in the U.S. Navy by Abraham Lincoln and who did perhaps more than any other man to popularize astronomy in the United States.

Tank-breeding Mosquitoes in Portsmouth

MR. JOHN F. MARSHALL of the British Mosquito Control Institute at Hayling Island, Hants, has recently issued a pamphlet on the above subject. It deals with the incidence of mosquitoes in static water tanks in the Portsmouth City area. Viewed as a whole, it appears that size of tank is an important factor since the occurrence of mosquito breeding becomes more and more unlikely as capacities increase above the 10,000 gallon limit. Tanks of 5,000 gallons and 10,000 gallons capacities (the two smallest employed) provided one half of the total cases of the occurrence of mosquitoes in some stage of development. In none of these examples was the water heavily infested: in all the larger tanks or sumps mosquito larvæ, when present, were few and far between. The only species of mosquitoes found breeding in the water-containers were *Culex pipiens* and *Anopheles maculipennis*, although many other kinds prevail in the district. On each occasion upon which mosquito breeding was observed, notification was sent to the National Fire Service authorities, who forthwith sprayed the infested water with oil and/or cleared it of algal growths. The success of these operations was evidenced by the fact that with only one exception no tank was found to be mosquito-infested more than once during the whole period considered (April–November).

New Zealand Earthquakes

ACCORDING to the seismological bulletin just received from the Dominion Observatory, Wellington, New Zealand, nine large earthquakes were registered during February 1943 by the seismographs at Auckland, Arapuni, Christchurch, Tuai and Wellington (Dept. of Scientific and Industrial Research, New Zealand Seismological Report, Provisional Bulletin No. P-132, February 1943, Dominion Observatory, Wellington, N.Z.). Additionally during the month twenty-seven shocks were felt in New Zealand. Three of these attained intensity VI on the modified Mercalli scale. The first, on February 17, occurred at 02h. 15·2m. U.T. and was felt in the South Island, south of Buller and Canterbury, with intensity rather greater than VI. The second on February 17, a 13h. 52m. U.T., was again felt in the southern par of South Island with intensity VI. The third on February 25 at 13h. 33·5m. U.T. was felt from Taumarunui and Napier to Hokitika and Akaroa with intensity VI. One shock had intensity V. It was on February 20 at 01h. 48·4m. U.T. and felt in the neighbourhood of Te Anau. Four shocks were felt with intensity IV and the remainder had lesser intensities.

Occultation of Venus

MR. M. A. ELLISON writes: "Permit me to correct and also to amplify the statement of planetary conjunctions given under 'The Night Sky in July' in NATURE of June 26, p. 724. These are described both as conjunctions and as occultations: in fact it is only the conjunction of Venus which leads to an occultation visible in the British Isles. This daylight occultation (disappearance July 6 at 15h. 45m. for Greenwich) is of special interest by reason of the great brilliancy of the planet, which should render it an object easily visible to the unaided eye. The moon will be slightly west of the meridian at an altitude of about 50°. There follows, within half an hour, the occultation of α Leonis, a double event observable with a 2-in. telescope".

Announcements

IF circumstances permit, the Trustees of the Lady Tata Memorial Fund will make the following awards for research in blood diseases, with special reference to leukæmia, in the academic year beginning on October 1: *Grants for research expenses:* Dr. J. Furth (New York); Dr. P. A. Gorer (London); Dr. A. H. T. Robb-Smith (Oxford); Prof. L. Doljanski (Jerusalem). *Part-time personal grant and grants for assistance and research expenses:* Dr. W. Jacobson (Cambridge).

THE following appointments and promotions have recently been made in the Colonial Service: G. A. Walton to be medical entomologist, Sierra Leone; E. Lawrence, agricultural officer, Nyasaland, to be senior agricultural officer, Nyasaland; W. E. Calton, laboratory assistant, Tanganyika Territory, to be assistant Government analyst, Tanganyika Territory; G. S. Brown, L. F. Higgens, L. Leslie Moore and W. S. Warne, agricultural assistants, Tanganyika Territory, to be senior agricultural assistants, Tanganyika Territory.

"RECOGNITION of Decay and Insect Damage in Timbers for Aircraft and other Purposes" is the title of a bulletin issued by the Department of Scientific and Industrial Research. It deals in the main with information for the use of timber inspectors and lists certain timbers in general use, with notes on their resistance to insect attack and decay. In its eighteen pages it deals with those defects and blemishes which occur most commonly in woods ordinarily used in the construction of aircraft and airscrews. The present shortage of timber has made it important to use it economically, and home-grown woods have been called on to make good the diminution of imports. The pamphlet is obtainable from H.M. Stationery Office or through any bookseller, price 6*d*. net.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Thermal Scattering of X-Rays by Crystals

THE influence of the thermal vibrations on the diffraction of X-rays by a crystal can be represented by a distribution of scattering power in the reciprocal lattice. The theoretical formula for this is the product of two parts: one, consisting of slowly varying factors which correspond to the atomic scattering factor, the polarization factor, Debye's temperature factor, the Lorentz factor, of Laue-Bragg scattering; the other part consisting of a function characteristic of the dynamics of the crystal vibrations, the diffusion factor $d(Q)$. For a simple lattice the latter has the form

$$d(Q) = \sum_{\alpha,\beta=1}^{3} S_{\alpha\beta}(Q) Q_\alpha Q_\beta, \quad . \quad . \quad (1)$$

where Q_1, Q_2, Q_3 are the co-ordinates in the reciprocal lattice, and $S_{\alpha\beta}(Q)$ are the elements of the scattering matrix S, periodic functions of the Q. S can be expressed as a function of the dynamical matrix D, which is defined in terms of the coefficient matrix of the second order terms of the potential energy of the lattice. At normal temperatures one has, with a high degree of accuracy,

$$S = kTD^{-1}. \quad . \quad . \quad . \quad . \quad (2)$$

The elements of $D(Q)$ have zeros in the reciprocal lattice points, hence those of $S(Q)$ have sharp peaks there. In the neighbourhood of these, they can be expressed in terms of the elastic constants of the crystal. In this way Jahn has calculated[1] surfaces of isodiffusion for sodium, and Mrs. Lonsdale and Mr. Smith have shown[2] that the results are in good agreement with observations.

Since the experiments show, for many materials, a definite structure of scattering power ('streamers' or 'bridges') in the space between the lattice points, it seemed desirable to have a method of calculating the matrix $S(Q)$ for any point of the reciprocal space. This can be done in two ways: either by using numerical calculations of the matrix D as published by Iona[3] for potassium chloride, and by Kellermann[4] for sodium chloride, or by using a crystal model for which D can be theoretically constructed. We have applied both methods. But as Iona's tables are rather rough, containing only four points on each edge of the elementary cube in the Q-space, the resulting figure for $d(Q)$ does not show much interesting detail; it is not worth while reproducing it here.

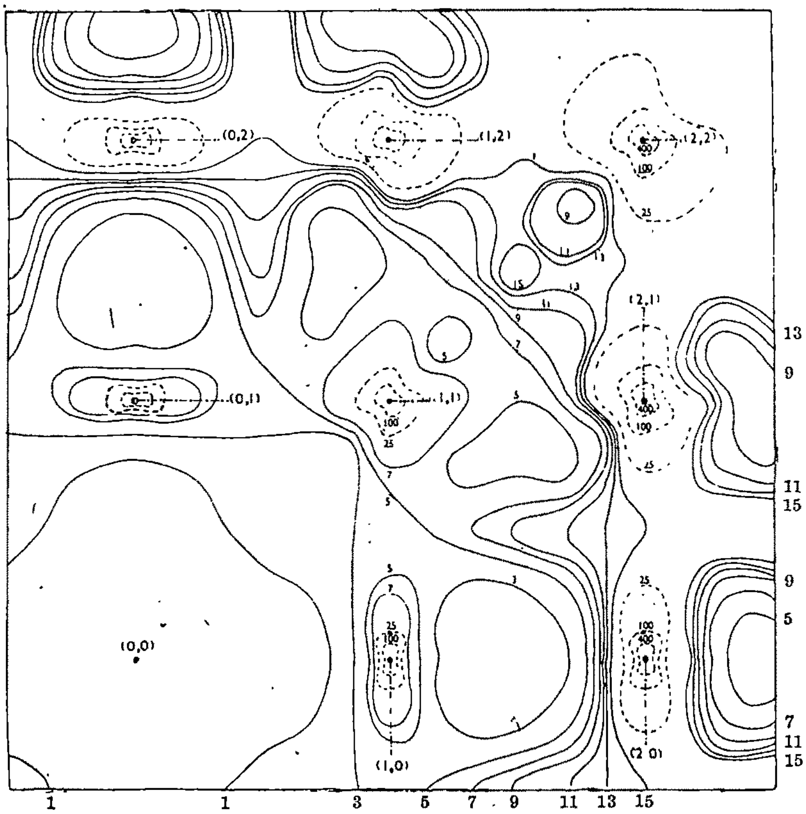
We have therefore developed the second method, taking as the model a face-centred cubic lattice in which only next neighbours act on one another, but with non-central forces. It can be shown that in this case there are exactly three force constants, which can be expressed in terms of the three elastic constants c_{11}, c_{12}, c_{44}. The typical elements of D are

$$D_{11} = (2c_{44} - c_{11})(1 - \cos Q_2 \cos Q_3) + c_{11}(2 - \cos Q_1 \cos Q_2 - \cos Q_1 \cos Q_3),$$

$$D_{23} = (c_{12} + c_{44}) \sin Q_2 \sin Q_3,$$

which for small Q go over, of course, into the expressions used by Jahn. We have in particular considered the plane $Q_3 = 0$, for which case it is not too tedious to form the reciprocal matrix D^{-1}.

In order to compare the results with the first method mentioned above, we took the constants c_{11}, c_{12}, c_{44} as those of potassium chloride, although this lattice is neither monatomic nor simple face-centred. Calculations for metallic crystals satisfying these conditions will be performed later.



Potassium chloride isodiffusion lines in the plane $Q_3 = 0$ of the reciprocal space (Q_1, Q_2, Q_3). The figures attached to the lines are the values of $d(Q)/kT$ if the elastic constants are made dimensionless by dividing them by $e^2/a^4 = 2{\cdot}40 \times 10^{11}$ dyne cm.$^{-2}$ (e is charge of the electron, a is lattice constant, 3·14 A.). The bracketed figures are the indices of the reciprocal lattice points, referred to crystal axes the lengths of which are one half those of the face-centred unit cell.

We computed the elements of D^{-1} and from this the diffusion function (1) for a sufficiently fine network of points. With the help of graphical interpolation, curves of isodiffusion were constructed which are given in the accompanying figure. This comprises nine reciprocal lattice points including the origin (marked by dots). In the vicinity of each of these (except the origin) one recognizes contours of the type found by Jahn. But one sees that the background has a definite and complicated structure; for example, secondary maxima (labelled 15). A remarkable feature is the existence of isodiffusion lines (intensities of 3 and 15, in our scale), forming almost squares which separate the whole field into unconnected sections. We hope that figures of this kind will provide additional evidence for the thermal theory of X-ray scattering.

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[1] Jahn, H. A., *Proc. Roy. Soc.*, A, **178**, 320; **180**, 476 (1942).

[2] Lonsdale, K., and Smith, H., NATURE, **148**, 628 (1941); **149**, 21 (1942). Jahn, H. A., and Lonsdale, K., *Phys. Rev.*, **61**, 375 (1942). Lonsdale, K., *Proc. Phys. Soc.*, **54**, 335 (1942).

[3] Iona, M., *Phys. Rev.*, **60**, 822 (1942).

[4] Kellermann, W., *Phil. Trans. Roy. Soc.*, A, **238**, 513 (1940).

IN a recent lecture-survey given to the Physical Society[1] it was shown that calculations based on the Faxén-Waller theory gave good agreement with experiment, not only within the regions to which that theory could properly be applied, but also in the short wave-length range where its validity was open to question. Thus diagrams showing the observed scattering power of KCl and Na in reciprocal space and the scattering power calculated by means of Jahn's formula were in general agreement not only in the neighbourhood of the reciprocal lattice points (region of long waves) but also at a distance from those points.

Prof. Born and Mr. Begbie have now extended the calculation for the special case of a monatomic face-centred cubic model having the same elastic constants as potassium chloride, and a lattice constant equal to one half that of the face-centred unit cell of potassium chloride. They have determined the scattering power over the whole of the reciprocal lattice network which includes the origin and the first five $\{hk0\}$ reflexions (together with other reciprocal lattice points derived from these by symmetry operations), and their published diagram shows that contours of the Jahn type do indeed account for very much of the diffuse scattering.

Although it is scarcely fair to compare the isodiffusion curves calculated for a simple face-centred cubic model with the experimental results for potassium chloride crystals, which may more truly be regarded as simple cubic, yet Born and Begbie's diagram possesses features which are apparently typical of the observed data for both potassium and sodium chloride. For example, Laval's ionization spectrometer measurements[2], which showed that the 200 and 220 domains ((1,0) and (1,1) in the above diagram) were completely surrounded by regions of weak scattering, but that between 400 and 420 ((2,0) and (2,1)) and still more between 600 and 620, there were 'bridges' of strong scattering, are now seen to be consistent with the theoretical predictions. It may be of interest to mention that the observed value of the scattering power at the middle of the 600–620 bridge is about 3·4 times the minimum scattering power appropriate to this angle, Compton scattering being subtracted from both observed figures. Inclusive of Compton scattering, the ratio is about 2·2 : 1.

Born and Begbie have commented upon the appearance of isodiffusion lines forming squares the sides of which are parallel to [100] [010]. Almost equally striking are the presence of other lines parallel to the diagonals [110] [$1\bar{1}0$]. 'Bridges' of both these kinds are clearly to be seen on the beautiful monochromatic photograph of sodium chloride published by Gregg and Gingrich[3].

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[1] Lonsdale, K., *Proc. Phys. Soc.*, **54**, 314 (1942).

[2] Laval, J., *Bull. Soc. Franç. Min.*, **62**, 137 (1939).

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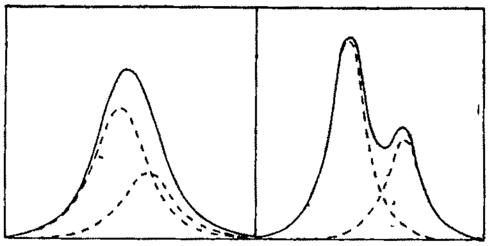
New X-Ray Evidence of the Nature of the Structural Changes in Cold-worked Metals

IN a recent issue of NATURE[1] W. A. Wood has published two interesting back-reflexion photographs from cold-worked steel, taken in the course of experiments to determine the nature of the deformation that causes the broadening of the X-ray lines. Such broadening may be caused both by the breakdown of the metallic grains into smaller crystallites and by variation of the lattice parameter from point to point in each crystal grain.

Dr. Wood compares the high-angle reflexions of molybdenum $K\alpha$ (0·7 A.) and cobalt $K\alpha$ (1·8 A.). In the former case the α-doublet is clearly resolved and in the latter it is not; Dr. Wood claims that this is a criterion which definitely shows that small crystallite size is the major cause of line broadening. Many factors, however, contribute to the broadening, and we consider that if they are all taken into account in this case the evidence is not so conclusive as Dr. Wood claims.

The two photographs show (1) line 10 (3 1 0) with cobalt $K\alpha$ radiation ($\lambda = 1\cdot79$ A., $\theta = 81\cdot1°$); (2) line 62 (7 3 2 and 6 5 1) with molybdenum $K\alpha$ radiation ($\lambda = 0\cdot71$ A., $\theta = 77\cdot7°$). (The θ values are those for a pure carbon steel; Dr. Wood does not give the composition of his specimen, but the angles are not likely to vary greatly.) In comparing these two photographs it must be borne in mind that (*a*) the breadths of the molybdenum lines will be less by a factor of 2/3 because of the lower Bragg angle; (*b*) the relative separation of the molybdenum $K\alpha$ doublet is three times that of the cobalt $K\alpha$ doublet, and this leads to a ratio of two in the actual separation on the films.



Cobalt radiation
Breadth of each component = 3·7 mm.; α-doublet separation = 1·76 mm.

Molybdenum radiation
Breadth of each component = 2·24 mm.; α-doublet separation = 2·48 mm.

Fig. 1.

We have attempted to assess the effects of these two factors in the case of lattice-parameter variation by taking hypothetical lines of average shape[2] at the respective Bragg angles, broadened in accordance with factor (*a*). The two components of the doublets are then added to give the shapes of the lines that would be observed. In Fig. 1 are shown the separate components (dotted lines) and the resultants (full lines) for the two radiations. It will be seen that

Specimen and radiation	Breadth (mm.)	Doublet separation (mm.)	Corrected breadth (mm.)	β (mm.)	θ	$\lambda R/\beta\cos\theta$ (cm.)	$\beta\cot\theta/R$
Cold-worked, Co	3·64	1·26	3·17	2·70	81·1°	$1 \cdot 93 \times 10^{-6}$	0·0094
Annealed, Co	1·31		0·88				
Cold-worked, Mo	3·25	2·48	2·24	1·84	77·7°	$0 \cdot 82 \times 10^{-6}$	0·0089
Annealed, Mo	1·04		0·69				

or cobalt $K\alpha$ one broad line is formed, but for molybdenum $K\alpha$ there are still two resolved lines; we doubt whether the difference between this result and the one that Dr. Wood shows photographically can be distinguished by eye.

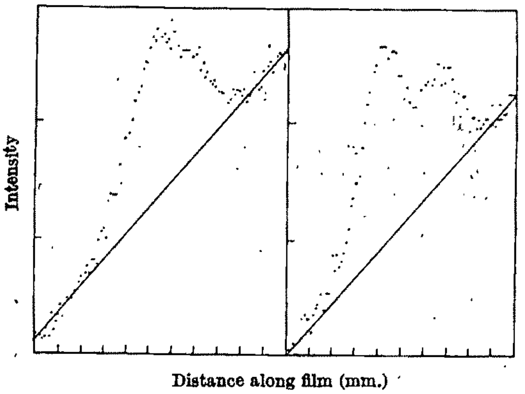


Fig. 2.

In order to examine the effect experimentally, we have taken X-ray photographs of iron filings in a camera of radius (R) 4·5 cm. with molybdenum $K\alpha$ and cobalt $K\alpha$ radiations and have made measurements on the highest spectra in each case. Photometer curves were obtained for both cold-worked and annealed filings. The curves for the former are shown in Fig. 2, and it will be seen that they resemble the hypothetical curves of Fig. 1 if allowance is made for the sloping background.

The data from the sharp lines given by the annealed filings were used to derive the diffraction broadenings, β, by the methods due to Jones[2]. The results are given in the accompanying table. The penultimate column gives the apparent particle size; the last column gives the apparent lattice distortion[3]. It will be seen that the latter is much more nearly constant than the former. Thus despite the extra visual sharpness of the molybdenum lines the detailed analysis shows that in this case the broadening is due mainly to lattice-parameter variation.

We have thought it advisable to use filings for these preliminary experiments since we are more familiar with the methods of analysing the results. The accuracy of these methods is greater than appears to be generally realized; it is definitely capable of distinguishing between broadenings proportional to sec θ and tan θ, even in line 3 of cold-worked copper. This was shown in a recent note from this laboratory[3]. An examination of the table that accompanied this note will show that if the broadening were due to small crystallite size, β should be of the order of 0·6 mm. at low angles. Since the total breadth of line 3 is only 0·64 mm., the diffraction broadening could scarcely be so great as this even if the methods of analysis were much less accurate than we suppose. We realize, however, that the nature of plastic deformation may be different in massive metal and in filings and we hope to perform further experiments, more closely resembling Dr. Wood's, to see if there is any difference in the two cases.

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June 2.

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[1] Wood, NATURE, 151, 585 (1943).
[2] Jones, *Proc. Roy. Soc.*, A, 166, 16 (1938).
[3] Stokes, Pascoe and Lipson, NATURE, 151, 137 (1943).

Value of the *p*F Scale of Soil Moisture for Expressing the Soil Moisture Relations of Wireworms

Subklew[1] and Woodworth[2] have shown that the cuticle of wireworms, Agriotes spp. and Limonius spp., is freely permeable to water, and the latter author also that it is permeable to arsenite ions. These findings have been corroborated and extended at Rothamsted, to show that when immersed in solutions of sucrose of varying concentration, anæsthetized wireworms (anæsthetized to prevent drinking and excretion) behave as an osmotic system bounded by a semi-permeable membrane.

Concentration of sucrose ..	0·00	0·15	0·30	0·45	0·60	0·75	1·00*M*.
Osmotic pressure in atmospheres	0	3·80	7·54	11·34	15·27	19·35	26·42
Vapour pressure depression (per cent) ..	0	0·28	0·56	0·85	1·14	1·45	1·98
Weight of wireworm after 4 days as per cent original weight ..	122·5	116·3	102·3	91·5	85·2	82·9	80·6

These observations show that had the wireworms been placed in a 0·33*M* sucrose solution they would not have changed in weight. This solution has a vapour pressure of about 99·4 per cent or a vapour pressure depression of 0·6 per cent.

Observations were also made on normal wireworms kept in samples of a rich loam soil at a series of moisture contents. The vapour pressure depressions of the various moisture contents were determined by the methods given by Schofield and Botelho da Costa[3] and Davidson and Schofield[4].

The accompanying graph is a log/log plot of the weight of the wireworms after seven weeks (original weight taken as 100) against the vapour pressure depression of the soil sample in which they were placed. When the depression is less than about 0·6 per cent the wireworms show no consistent change in weight, intake of water through the cuticle being balanced by excretion. When it exceeds 0·6 per cent,

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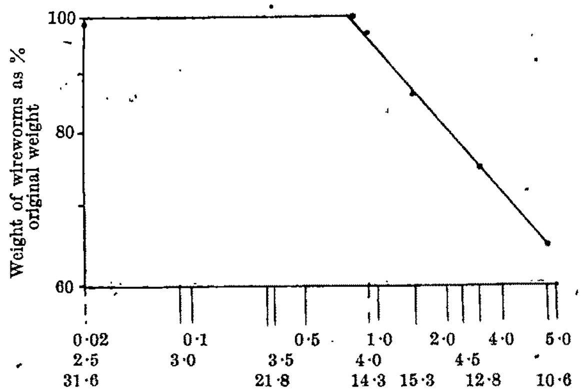

Abscissa (top): Vapour pressure depression (%).
,, (middle): pF.
,, (bottom): Moisture (%).

water is lost chiefly through the cuticle, there being little or no excretion. In the drier soils the vapour pressure depression is due mainly to the 'suction' of the soil moisture, that is, to the fact that the water retained in the soil pores has a pressure less than that of atmospheric pressure. A suction of eight atmospheres produces a depression of 0·6 per cent. Adopting the scale proposed by Schofield, in which pF represents the logarithm of the height in centimetres of a column of water corresponding to the suction, we can say that the wireworms were in moisture equilibrium with the soil at pF 3·9.

Further experiments with other soils have confirmed that the rate of loss of water is governed by the 'suction' and not by the moisture content of the soil.

Type of soil	% Moisture content at pF 5·0	Weight of wireworms after 5 weeks as % original wt.
Woburn Sandy ..	4·03	56·7
Rothamsted allotment ..	7·52	55·9
Rich loam	10·38	56·9
	pF at a moisture content of 10·38	
Rothamsted allotment ..	4·1	86·9
Woburn Sandy	3·6	102·2

It is quite clear that the pF scale suitably expresses the dryness or wetness of a soil in relation to the loss of weight of wireworms, and should prove of value in studies of a similar kind.

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May 28.

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[2] Woodworth, C. E., *J. Agric. Res.*, **57**, 229 (1939).

[3] Schofield, R. K., and Botelho da Costa, J. V., *J. Agric. Sci.*, **28**, 644 (1938).

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Effect of *p*-Aminobenzoic Acid on Defective Cultures of Bacteria

IT has been shown by C. E. Cahn-Bronner[1] that the phenomenon of bacterial zones can be produced by partial starvation.

Some aerobic bacteria and yeasts were found to grow in a layer under the surface of the fluid culture with increasing starvation such organisms were mo sensitive to oxygen, which had a mildly bacteriostat effect on them.

This phenomenon of sensitivity to oxygen is d to lack of easily oxidizable substances, mainly carb hydrates, in the medium (acting as oxygen acceptors This type of growth is also observed in cultures *B. subtilis* grown on semi-synthetic medium co taining hydrolysed casein. Strains of *B. subtil* grown on digest broth produce a normal growth aft 24 hours in the form of diffuse turbidity and a pellicl on the surface of the medium, whereas on the syn thetic medium described by Leonard and Holme with 0·1 per cent acid-hydrolysed casein instead proteose peptone, there was weak growth in the for of slight turbidity in the deeper layers of the cultu after 24 hours but no pellicle on the surface. I absence of hydrolysed casein, growth was still les noticeable, and it was several days before the turbidit was sufficient to be estimated. Surface growth wit normal pellicle formation occurred when *p*-amin benzoic acid was added to the medium in a con centration of 1 : 2,500 to 1 : 1,100,000. In absence o hydrolysed casein, however, surface growth did no take place within 24 hours.

The addition of 4 per cent human serum to th synthetic medium had the same effect as the addition of *p*-aminobenzoic acid (and hydrolysed casein) Addition of sulphonamide compounds having anti bacterial properties in dilutions up to 1 : 100,00 inhibited the surface growth-promoting effect o *p*-aminobenzoic acid in the synthetic medium. Thi probably explains Mandelbaum's observation o bacterial asthenia[3].

Another example of defective growth under th influence of sulphonamide drugs is shown by culture of *Ps. pyocyanea* in synthetic medium, in which no only is there scanty pellicle formation but also deficiency of pigment formation over a period o 24 hours when sulphonamides are added in dilution from 1 : 5,000 to 1 : 50,000. *p*-Aminobenzoic aci antagonized the adverse effect of the compounds i dilutions up to 1 : 50,000.

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[1] *Proc. Soc. Biol. and Med.*, **45**, 454 (1940).

[2] *J. Immun.*, **29**, No. 3, 209 (1935).

[3] NATURE, **147**, 266 (1941).

Archæology as a Science

THE antithesis between history and science as central disciplines in "education for citizenship" can be resolved by making history more archæological and recognizing that archæology is a science. Mr. Hansel's just complaint[1] that "the humanities specialize in inhumanity—instruction in the accumulated evil, strife and intrigue of the ages" does not apply to prehistory, which is exclusively archæological—and archæology does not stop short when written history begins. For archæology, evil is not cumulative—one might be tempted to say, is what is not cumulative. In the archæological record (in a

Mesopotamian *tell*, for example) the destruction wrought by strife is overshadowed by reconstruction. What archæology reveals is precisely "the progress of mankind—of art, science and industry" from the painted caves of mammoth-hunters not only to the early cities of Sumer and Crete but also right down to Manhattan and Magnitogorsk. Flint axes and rotary querns, the history of which is provided by archæology alone, are just as much embodiments of science as the cyclotron. The cowrie shells from the Mediterranean adorning a Cro-Magnon skeleton in central France 30,000 years ago and the seals imported from India to Ur 4,500 years ago are just as reliable indexes of intercourse (and so of the pooling of ideas) as Board of Trade lists.

On the other hand, the methods of archæology—accurate and dispassionate observation, systematic comparison and classification, the continual reference of explanatory generalizations to the concrete data derived from observation—are truly scientific. An archæological excavation is an experiment, albeit an experiment that can never be repeated; it should be resorted to, as Collingwood insisted, primarily to test a hypothesis. Archæologists also find out by experiment how pigmy flints were made, how pots were coloured and how the ramparts of forts were 'vitrified'[2].

Prehistoric archæology at least may be deemed to have become a science in 1859. In that year Evans and Prestwich, by confirming Boucher de Perthe's claims as to the antiquity of his artefacts from the Somme gravels, vindicated the existence of pleistocene man; and Darwin, by winning acceptance for the view of man as part of Nature, not only made human history a continuation of natural history, but also gave Nature a history as well as man (as Millar so ably insists in "Science and History"). The methods of prehistory have, especially during the last twenty-five years, been increasingly applied to the study of historical periods too. Hence a lesson in archæology, even if it consist only in the comparison and classification of rusty bolts and broken tobacco-pipes from a town rubbish pit, could be at once a lesson in science and a lesson in history. But not only should it be "more stimulating and elevating", but also more interesting and easier to understand than lists of kings and battles, persecutions and proscriptions.

The corollaries would be, on one hand a more generous treatment of archæology by the State and local authorities, on the other a fuller recognition of the subject's scientific status by universities and institutions. More space, more staff and better equipment are required if existing archæological collections are to be made genuinely educational. In Scandinavia, Czechoslovakia and the U.S.S.R., I have been almost embarrassed by the streams of school classes being taken through museums by their teachers; in few museums in Britain are the archæological galleries large enough or the exhibits so arranged as to encourage this procedure. Funds are needed for further excavations not only to enlarge collections and provide sites for educational visits, but also and more seriously to recover the context within which dead monuments and relics can come to life. A more prominent position might be given to archæology in university curricula even where archæological departments already exist; for the universities must provide the teachers of archæological history and are best fitted, to direct research and experiments that cannot be repeated. Finally, the contacts between archæologists and (as I should like to put it) the other men of science might be made closer than they are and given formal recognition.

V. GORDON CHILDE.

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University of Edinburgh.

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[1] NATURE, 151, 168 (1943).

[2] Childe and Thorneycroft, "The Experimental Production of the Phenomena of Vitrifaction", *Proc. Soc. Antiquaries Scotland*, 72, 44.

Fortieth Anniversary of the University of Peiping

THE first volume of a book commemorating the fortieth anniversary of the foundation of the University of Peiping was recently published here. The distribution was to have been from Shanghai, but owing to war conditions it is doubtful if any copies were ever sent out. The following is a list of the papers contributed to the volume.

Chang Hsi-Chih: "Observations on the Geological Structural Features in Western Yunnan".

Chang Hsi-Chih and Y. C. Sun: "New Graptolite Faunas from Lientan, Kwangtung".

Lu Yen-Hao: "Ontogeny of *Ptychoparia Szechuanensis* Sun".

Y. C. Sun: "On the Occurrence of Fengshanian (late Upper Cambrian) Trilobite Faunas in Western Yunnan".

Y. C. Sun: "The Uppermost Permian Ammonoids from Kwangsi and their Stratigraphical Significance".

H. C. T'an: "Preliminary Report on the Geology of the Tzuhsing Coal Field in Southern Hunan".

H. C. Wang: "Geology of the Kunming Region".

Yung Chung-Chien: "Preliminary Notes on the Lufeng Saurischian Remains".

Yueh-Chiang Chen: "Notes on some Freshwater Amphipods of Peiping".

Man-Chiang Niu: "The Anatomy of a Salamander, *Triturus Orientalis* (David)".

Man-Chiang Niu: "A Comparative Study of the Skeletons of *Ophiocephalus argus cantor* (Ophiocephalidæ) and *Parasilurus asotus* L. (Siluridæ) with those of *Carassius auratus* L. and *Ctenopharyngodon idellus* C. and V. (Cyprinidæ)".

Chia-Tui Shen: "The Larval Development of Some Peiping Caridea—Caridina (Atyidæ), Palæmonetes and Palæmon (Palæmonidæ).

H. C. Yin: "Effect of Auxin on the Pigment-content, Respiration, and Photosynthesis of *Chlorella vulgaris*".

T. L. Woo: "Anthropologische Studien über die Chinesische Patella".

Wentworth Chu and Chung-Kwei Chang: "Transients of Resistance-terminated Dissipative Band-Pass Electric Wave Filters".

Edith Ju-Hwa Chu: "A Modified Procedure for Preparing *o*-Bromobenzoic Acid".

S. L. Chien and Y. F. Sui: "The Dipole Moment of 2,2′, 4,4-Tetranitrodiphenyl".

If any scientific workers in Britain or America would like to receive copies of any of these papers, we can arrange to send them in typewritten or mimeographed form. Requests should be addressed through Dr. J. Needham, via the British Council, 3 Hanover Street, London, W.1.

CH'ANG CH'ING-YUEH
(Professor of Botany, University of Peiping).

JOSEPH NEEDHAM
(British Scientific Mission in China).

SUN YÜN-CHU
(Professor of Geology, University of Peiping).

Kunming, Yunnan.
March 18.

RESEARCH ITEMS

Origin Myth of the Acoma Pueblo Indians

M. W. STIRLING has brought together all the available information in regard to the origin myth of Acoma (Bur. Amer. Ethnol., Smithsonian Inst., Bull. 135). It seems to be a psychological fact that all thinking peoples like to evolve a creation legend for themselves or to borrow one already in existence. The primordial cow licking a lump of salt in Norse legends and the Babylonian account of the creation of the world, of which the first chapter of Genesis is but a spiritualized version, at once come to mind. Humanity has always been interested in origins, and it likes the start of things to be as simple as possible. Even stories of natural phenomena tend to become simplified into a single account. Thus we find deluge legends almost universally. These generally differ entirely in form, and there is no reason to trace any cultural connexion between them. At the same time, the workings of the human mind are extremely interesting, and the various fundamental legends excogitated by folk in different parts of the world are necessarily of great importance. In the case of the Acoma, everything started with two women who were born underground (how is not stated) at a place called Shipapu. There was also a creative spirit called Tsichtinako who acted as their guardian, brought them to the surface of the ground, gave them images of animals and plants, and showed them how to give these life and how to distribute them to the various points of the compass. Of course in due time human beings were given life, this time apparently through the fertilizing of the women by Tsichtinako himself, and were taught various taboos and ceremonies. All these happenings are reproduced in play-acting when various ceremonies take place during which a ladder is mounted to represent the emergence of the two women from the depths of the earth—the ladder is supposed to represent the rainbow, by the way—and elaborate hunting and other scenes occur, considered to reproduce the instructions given by Tsichtinako. There is also a spirit of evil, as well as what seem to be guardian spirits. These, too, appear in the ceremonies. The 114 pages of the Bulletin—with many full-page illustrations, one in colour—repay careful perusal.

Noctuid Moths at Light Traps in America

H. H. WALKDEN and D. B. Whelan discuss the trapping of owlet moths (Phalœnidæ or Noctuidæ) by means of light in Kansas and Nebraska in Circular No. 643 of the U.S. Department of Agriculture (Nov. 1942). By the use of light traps located at six widely separated points in the Missouri Basin, information was obtained regarding the seasonal occurrence and abundance of a group of moths containing many notoriously injurious pests. During a four-year period (1934–37) 305 species of these moths were captured, totalling more than 525,000 individuals. About 90 per cent of the specimens taken were species of economic significance. More than 36,000 individuals were examined for sex, and it was found that 35 per cent were females but that the sex ratio varied greatly with the species. The number of moths taken differed greatly in the different localities and also from year to year. In general, flights of individual species showed the same trend in all the localities. Species having a single annual generation had rather a short flight period, usually from late August until early October. *Chorizagrotis auxiliaris*, however, had an enormou flight in May and June, followed by a much lighte flight in the fall. Owing to the overlapping of brood the flights of different generations of multiple generation species were not clearly defined. It i considered that the data obtained are basic to, or o value in, the consideration of cultural control an other methods for the suppression of the variou pests involved. Although the response to light varie with different species, it is probable that the numbe of individuals recorded is a fairly reliable estimate o the relative abundance of the species in the area concerned.

Studies in Siricidæ or Wood-wasps

R. B. BENSON has discussed the members of thi family that occur more especially in Europe and southern Asia (*Bull. Entomol. Res.*, **34**, 27 ; 1943). Included in his paper is also a key to the genera of the world. The two subfamilies Siricinæ and Tremecinæ are taken to be valid groupings that are supported by biological differences. So far as is known the former are wholly associated with conifers and the latter with angiospermous trees. Two ratios are introduced as characters for specific differentiation, namely, the ovipositor/fore-wing ratio and the sawsheath/ovipositor ratio. These ratios were found to hold good in all the specimens in the British Museum collection and, furthermore, were found not to vary with the size of the insects. In dealing with the British members of the Siricidæ it is suggested that *Urocerus gigas* subsp. *taiganus* nov. and the form of *Sirex juvencus* Ll. with entirely black antennæ may be native in the Caledonian forest. The extinct family of the Pseudosiricidæ, the remains of which are common in the Upper Jurassic strata of Bavaria, is remarkably similar to the Siricidæ but the cross-veins in the fore-wings are greatly reduced. Since it is unlikely that these cross-veins, after having become lost in the Jurassic Pseudosiricidæ, should have been regained in modern sawflies it is considered that the first-named group could not have been ancestral to the Siricidæ as believed by some workers. The paper concludes with a list and short discussion of the Oriental and Himalayan Siricidæ.

A New Source of Pectin

PRACTICAL importance may be attached to the discovery, reported by T. P. Ghose and S. Krishna in *Indian Forest Leaflet* No. 23, 1942, from the Fores Research Institute, Dehra Dun, that the seeds o *Tamarindus indica* contain a very high proportion o pectin (some 58 per cent of the kernel being obtained as a crude alcohol precipitate). The tamarind is cultivated throughout India, Burma and Ceylon, mainly for the sour fruit, an enormous quantity of which i consumed ; at present the seeds are usually thrown away, so that if arrangements can be made for thei retention and collection a low-priced source of pecti should be available and one which permits readil of storage and transport until such time as it is convenient to extract the pectin. Particulars are give of a method of extraction and isolation of the pectin which readily forms a firm jelly with suitable proportions of sugar and citric acid.

Fruit Production

M. B. Crane and A. G. Brown (*J. Genet.*, **44**, 160 1942) show that in some varieties of plums pollination with different varieties gave various difference in the time of maturity and in the size of the fruit. The pollen influences the fruit in so much as defective embryos give rise to earlier ripening and smaller fruits. The developmental differences in the fruit are an expression of different degrees of seed developments. Thus seedless fruits from diploid × hexaploid ripen first, seeded fruits of $2X \times 4X$ ripen next, and $2X \times 2X$ ripen last. These authors and D. Lewis (*J. Pomol.*, **20**, 40; 1942) point out that seedless fruits of Fertility and Conference pears have been obtained after frost treatment.

Deep-Focus Earthquakes and Aftershocks

Ross R. Heinrich discusses this question in connexion with the earthquakes which centred near the Ecuador-Colombia border during May, June and July, 1942 (*Earthquake Notes*, 14, Nos. 1 and 2; 1942). This series apparently began with a very violent shock on May 14, 1942, at 2h. 14m. U.T. and ended with a widely recorded shock on July 12, 1942, at 5h. 06m. U.T. Examination of the data so far received by the Central Station of the Jesuit Seismological Association, and of the St. Louis, Florissant, Cape Girardeau and Little Rock seismograms reveals difficulties in the interpretation of S and the determination of the depth of focus. This is not unknown in the case of earthquakes in the same region. The S phase is characterized by an emersio followed at a fair interval by an impulse of considerable magnitude. The interval and general character of the e and i vary on different components and instruments. Moreover, in the distance range of the North American stations the S phase is preceded by PS, and this adds further to the confusion of the interpretation. The strength of the preliminary phases as compared with the surface waves would suggest deep-focus earthquakes, and this interpretation agrees with the macroseismic evidence. However, pP and sS are difficult to discern though at St. Louis the $(sS-S)/(pP-P)$ ratio suggests a focal depth in the region of 500 km. If the above interpretation is correct, this swarm should furnish some interesting data on deep-focus earthquakes, but whatever the final analysis, it seems evident that these earthquakes are genetically associated.

Tuberculin Proteins

F. B. Siebert and J. W. Nelson (*J. Amer. Chem. Soc.*, **65**, 272; 1943) have shown that tuberculin contains at least two protein components which can be distinguished by different mobilities in electrophoresis. The molecular weights appear to be about 32,000 for the slower and about 16,000 for the faster. Both have immunological specificity, but the larger one is more potent as a tuberculin and more antigenic. The smaller molecule may elicit antibodies which appear with the faster serum components, α-globulin or even albumin.

Acyl Migration in Steroids

A remarkably facile acyl migration, so far without analogy in the steroid series, has been found by V. A. Petrow, O. Rosenheim and W. W. Starling (*J. Chem. Soc.*, 135; 1943) to occur in the monoesters of *cis*-Δ^5-cholestene-3 : 4-diol. The 3- and 4-monoesters were prepared by methods described, a new and elegant method being used for the preparation of the 4-esters from cholesterol. An acyl migration from C_3 to C_4 occurs on warming the 3-monoacetate of the *cis*-diol in acetic acid solution, the reaction being reversible, and another example was found in the successive substitution of chlorine for hydroxyl and hydroxyl for chlorine at C_4 in 3-acetoxy-Δ^5-cholesten-4-ol. An intermediate formation of orthocarbonic esters, analogous to that occurring in acyl derivatives of glycerol and carbohydrates, is suggested as an explanation of the reaction, but an alternative mechanism involving a transannular tautomerism is also discussed.

Welding of Cast Iron

The welding of broken or worn iron castings is reviewed by J. G. Pearce (*Quart. Trans. Inst. Welding*; Oct. 1942), and a preliminary report of some experimental work on the same subject by W. J. Driscoll appears in the same publication. It is shown that welding can be successfully applied to a wide range of repair work more cheaply and expeditiously than by replacing the casting itself. The most popular process is by bronze welding, which is the only one available for malleable cast iron. When employing this method, little preheating is required, and since the fusion temperature of the bronze is well below that of the cast iron, there is less risk of cracking or distortion. The weld is but little weaker than the parent casting and is easily machined. The main disadvantages of this process are that the weld is unsuited to service at elevated temperatures, and that the penetration is not great. Using a fusion method there is much better penetration, and, especially in the case of oxy-acetylene welding, good strength. The higher temperatures involved in the welding result, however, in a greatly increased risk of distortion and possibly even of the cracking of the casting under repair.

Solar Prominences and Sunspots in 1937

Observations of solar prominences for 1937 were conducted at the University of Valencia with the equatorial Zeiss, aperture 15 cm. and focal length 2·2 metres; a spectroscope which was previously at the Observatorio Astronómico de Madrid was adapted to the Zeiss for prominence work (*Bol. Ast. Observ. Madrid*, **2**, No. 8; 1942). The first part supplies the usual information on prominences, date and time, position angle, heliographic latitude, height, etc. Letters in the last column are used to classify the prominences according to their brightness, the chromosphere being used as the basis for this comparison. Thus, *v* denotes a prominence which is as bright as the chromosphere and *vv* signifies a prominence of the brightest class observed. When the letter *d* is used the prominences are considered to be well defined, though less bright than the first two, and when *dd* appears the light is so feeble that it is comparable with that of the spectrum. The second part shows the distribution of the prominences in zones of 5° area, under each quadrant separately, and the third part gives the mean areas in each zone for every month of the year. Part four shows the number of prominences and their areas for the various zones in each quadrant, and the last part supplies a useful summary of the work for each month. The last eight pages are devoted to the observations of sunspots in 1937 at the University of Valencia. Most of the observations were carried out by M. Martin Lorón and were checked by R. Carrasco. Reductions of observations and computations were effected by E. Gullón.

CANCER RESEARCH

THE annual report for 1943 of the director of the Imperial Cancer Research Fund* makes encouraging reading, not because any startling or dramatic results emerge, but because the problem continues to be assailed on sound scientific lines by a number of different methods which are fully coordinated. Dr. W. E. Gye reports that during the past year work has centred almost entirely on experiments relating to mammary cancer in mice, the induction of cancer with pure chemicals, the action of hormones on the pituitary body and on the prostate gland, and to chemotherapy.

As regards carcinogenesis, H. G. Crabtree's earlier work has shown that a series of halogen compounds, graded with respect to their power of checking cell-glycolysis, could retard the development of skin tumours induced by pure chemical substances. The halogen compounds used could also affect other chemical cell-mechanisms, in particular those involving the sulphydryl group; for example, glutathione, enzymes containing sulphydryl groups as active centres, or the normal synthesis of proteins with sulphur-containing amino-acids in their essential composition. Recent observations suggest that sulphur metabolism is a factor in the artificial induction of cancer; it may also assist in determining the occurrence of spontaneous mammary tumours in inbred strains of mice.

The general growth-inhibiting properties of many carcinogenic and non-carcinogenic hydrocarbons seem to be related to the depletion of sulphur-containing amino-acids which co-operate in their elimination. Experiments have been made on the effect of tumour induction when sulphur metabolism is disturbed. One method consisted in the application of bromobenzene to the skin. This substance in the organism is detoxicated by combining with cysteine and is then eliminated as a mercapturate. Crabtree has demonstrated the inhibiting effect of bromo-benzene on the formation of skin tumours in mice by 3 : 4-benzpyrene. The earlier types used in these inhibiting experiments, by virtue of their mobile halogen atoms, can react with the sulphydryl type with elimination of halogen acid, while the present type reacts by a coupled oxidation in which the relatively unreactive halogen remains as a constituent of the resulting mercapturate. This inhibition of tumour induction probably occurs with both types of compounds under conditions of localized sulphur deficiency, which suggests that sulphur metabolism is intimately concerned in the processes of chemical carcinogenesis.

Dr. B. D. Pullinger has continued her study of the Deelman phenomena, that is, the localization of tumours in scars and healing wounds. Her experiments indicate that trauma, as represented by excised wounds, has a slight stimulating action in increasing tumour incidence. Her work also suggests that the intervention of some specific carcinogenic chemical is necessary to stimulate or originate tumour growth, as well as the added non-specific action of trauma.

Cramer and Horning's work has shown that there is a reciprocal action between the sex organs and the pituitary body. Pursuing this work, Dr. Vaquez-Lopez has studied the effect of œstrinization in a number of species of animals. In the hamster, for example, when œstrogenic substances (œstradi benzoate and diethylstilbœstrol) were subcutaneous implanted, the epithelial cells of the pars intermed of the pituitary body multiply and invade t posterior lobe, which consequently enlarges. T invasion often replaces the whole of the pars nervo and may extend along the neurohypophysis to t brain. In mice a similar enlargement takes place the anterior lobe of the pituitary body. This ho monal stimulus causes an extension of a norm process; it is an invasive phenomenon, not a ne growth, for there is no defensive reaction of ner tissue to the emigration of intermedia cells, such occurs in the event of an invasion by alien cell Long-continued treatment with œstrogens gives ri to profound changes not only in the organs of intern secretion, such as pituitary gland, the supraren glands and the islets of Langerhans in the pancrea but also in the testis, the mammary gland and th prostate. This work, then, bears upon the enlargemen of the prostate in old age and, possibly, its tendenc to malignant disease. Horning is now investigatin the effects of œstrinization on the prostatic glands pure-line mice of high and low incidence of mammar cancer.

Interesting work has been done by Dr. R. J Ludlow and Miss H. Barlow on tissue cultures. Th cell characteristics of primary tumours, both spontaneous ones and those induced by œstrin and chemicals, have been studied, as well as the action o malignant and non-malignant cells on fibroblasts *i vitro*. The latter research leads to the conclusio that some product of the metabolism of growin epithelial cells stimulates the growth of fibroblasts

Mammary cancer in inbred strains of mice, o which Bittner, Andervont, Little and W. S. Murra in America have recently done much work*, has bee further studied by Dr. Ludford and Dr. L. Dmochowski, and Dr. Ludford and Miss Barlow have continued their work on chemotherapy.

Knowledge of cancer increases year by year, an this report is no mean contribution to a proble which is gradually emerging from obscurity.

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* Fortieth Annual Report, 1942–1943, of the Imperial Cancer Research Fund. Pp. 32. (London: Imperial Cancer Research Fund, 1943.)

* Bittner, *Trans. Stud. Coll. Phys.*, Philadelphia, 9, 129 (1941).

PROTECTIVE SYSTEMS FOR RURAL ELECTRICAL DISTRIBUTION

A SYMPOSIUM of four papers on this subject was presented before the Institution of Electrical Engineers in London on May 12. In the first paper, by D. C. Field on systems up to 33 kV., the general principles of protection are discussed, emphasis being laid on the importance of considering the prevention of faults as well as their isolation. From an analysis of the causes of interruptions, which shows that a large number are only transient, and from the special conditions pertaining to a rural system, it is concluded that it is preferable to restrict the number of points at which automatic protection is provided, in order to facilitate the rapid resumption of supply. The methods of protection adopted in one large rural area are briefly described, together with a summary of the experience gained in operating several classes of equipment, including arc-suppression coils, auto-reclose switches and fusegear.

The second paper, by O. Howarth, is confined to 11 kV. networks and consists of a description of the ea supplied by the Lancashire Electric Power Co., nd of the nature of supplies afforded in that area. he 11 kV. distribution system and the protective rangements employed thereon are described, and gures showing availability of supply to consumers uring a period of one year are given. The testing cessary to ensure satisfactory functioning of the otective gear is also dealt with. The experience of he Lancashire Electric Power Co. indicates that with duplicate tail-end feeder system, simple overload and arth-leakage protection will ensure the minimum of nterruption of consumers' supplies provided adequate sts are made to prove the reliability of the gear. Where two or more feeders operate in parallel between nding and receiving stations, and provided the load apped off along the route does not exceed about 0 per cent of the normal load of the feeder, very atisfactory discrimination can be obtained with arallel-feeder protective systems.

In the third paper, by R. W. Steel and A. W. llwood, systems up to 33 kV. are considered, and he importance of installing suitable and efficient rotective apparatus on rural networks, at all stages f their development, is emphasized. A typical proective scheme, including arc-suppression coils, for an 1 kV. and 33 kV. rural distribution system which has een put into operation in a particular area of supply s described, and the reasons leading to its adoption re given. The practical difficulties met with in ecuring efficient operation and of carrying out roper maintenance are discussed and some statistical ecords of fault interruptions are presented. These ndicate the number and type of faults causing total r partial failures of supply and show the conditions under which the protective gear is called upon to unction. The nature of the faults which occur on ural networks is analysed and a suggested standard orm of keeping fault statistics is put forward for general adoption by undertakings distributing in ural areas.

The fourth paper, by K. I. Brown, deals more particularly with the automatic selective isolation of sustained earth-faults on a network protected by Petersen coils, and explains what is believed to be a unique method evolved for the protection of a grid network of 37·5 kV. transmission lines against line-o-earth faults, which enables automatic selection and isolation of a section subjected to a sustained fault to take place without utilizing earth fault current for the operation of protective relays, or pilot wires between sectionalizing stations remote from one another. The scheme provides for the installation of Petersen coils together with special automatic selectors and associated equipment, and has been employed with considerable success since 1936 for protection of the Ganges Canal hydro-electric grid in the United Provinces, India.

The paper shows that by introducing Petersen coils and automatic selector equipment to the system, almost complete immunity from outages due to temporary line-to-earth faults had been achieved, and that in the case of a sustained line-to-earth fault the affected section can be selected and isolated automatically within a period of 30 sec. from the instant of fault, without any 'kick' being experienced by the power stations. No pilot wires are required between selector stations. The existing overload relays continue to protect the system against line-to-line faults, and if desired the original form of earth-leakage protection may be restored to the system by the manipulation of earthing switches.

To certain criticisms of the scheme that (*a*) there is the possibility of line surges occurring due to switching on a system entirely protected by Petersen coils, and (*b*) the interruption in supply to substations connected to healthy lines between switching points must of necessity sometimes be experienced, it can be replied that no surge effects have been observed and the transformers, switchgear and line insulators have not been affected thereby, while since the majority of faults recorded clear before any sectionalizing takes place and as sustained earth faults are infrequent, momentary interruptions to load points are few. The probability of the selectors having to complete full sequence of operation in the event of a sustained earth fault is small, as there are eleven sections on which the fault may have occurred and it is only in the event of the fault being on the last section in the series, or in a substation structure, that the full sequence of operation takes place.

THE TERMITES OF AUSTRALIA

By Dr. A. D. IMMS, F.R.S.

UNDER the above title there has recently appeared a timely and much needed monograph*. The author, Mr. G. F. Hill, has been an active worker on termites for many years and has an unrivalled acquaintance with these insects in so far as Australia is concerned. There are many difficulties to be contended with in the study and investigation of termites, and it is for this reason that monographs are badly needed from nearly all parts of the world that are inhabited by these creatures. Excluding the United States, which has a relatively meagre termite fauna, Australia is to be commended in giving a leading hand by furthering publication of an account of her native species. But the availability of a competent authority is about two thirds the battle—other lands are not so far equally favoured. India, perhaps more than any other part of the British Commonwealth of Nations, needs a proper monograph on her rich and vast termite fauna, that is productive of almost incredible damage to human effort. A sound monograph on this order is worth many of those on the more obscure orders, and it is to be hoped that a competent worker will be forthcoming one day, not too far distant, who will cope with the task.

But, as previously said, the difficulties are manifold when it comes to identifying these insects. The soldier caste affords the best and most reliable character—the winged imagines are seasonal and not so often met with in consequence, while the workers (that have earned for termites their notoriety as destroyers of products serving man's convenience) show ill-defined features that make their specific determination a thing of great uncertainty. Apart from the incidence, then, of three different castes of individuals in each species, it needs to be taken into account that two or more different species may inhabit the same mound or piece of wood. It often happens that two or more species of very distinct habits are almost indistinguishable in form and structure, and that individuals of the same species may differ very much in different regions so as to be mistaken as belonging to more than a single species. Difficulties of this kind have naturally given rise to much confusion regarding the specific identity of so many of the Australian termites, as elsewhere.

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* Termites (Isoptera) from the Australian Region. By Gerald F. Hill. Commonwealth of Australia Council for Scientific and Industrial Research. 479 pp., 353 text figs. and 24 plates. (Melbourne, 1942.)

Much spade work has been undertaken by Mr. Hill in getting discrepancies of this type properly cleared up. During the progress of this work about nine thousand termite colonies have been examined. Altogether 217 species have been recorded from the region under review, which includes also New Guinea and islands south of the equator between 140° E. longitude and 170° W. longitude.

Among this rich fauna is included the most primitive of all termites—*Mastotermes darwiniensis*, which happens, also, to be the most destructive among the Australian species. A thorough study of this 'key' form should throw much light on the many outstanding problems of termite economy and would form an admirable subject for a young and promising Australian zoologist to embark upon. The present monograph loses nothing by the letterpress being reproduced photolithographically owing to need for economy, and the line drawings form a valuable adjunct. In a short notice of this kind little more can be written other than to direct attention to the importance and excellence of the work in question, which will probably long remain a standard monograph.

FORTHCOMING EVENTS

Saturday, July 3

NUTRITION SOCIETY (JOINT MEETING WITH THE FOOD GROUP OF THE SOCIETY OF CHEMICAL INDUSTRY) (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 11 a.m.—Discussion on "Milk" (Chairman: Prof. H. D. Kay).

LONDON MATHEMATICAL SOCIETY (JOINT MEETING WITH THE LONDON BRANCH OF THE INSTITUTE OF PHYSICS) (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 2 p.m.—Dr. A. C. Aitken, F.R.S.: "Matrices in Practical Mathematics"; Dr. L. J. Comrie: "Computational Methods and Mathematical Tables"; Mr. H. L. Blackburne: "Mathematical Solutions by Models"; Dr. S. Whitehead: "Applications of Elementary Mathematical Processes, with special reference to Circuit Theory".

Saturday, July 3—Sunday, July 4

TOWN AND COUNTRY PLANNING ASSOCIATION (at the Waldorf Hotel, Aldwych, London, W.C.2), at 10.30 a.m.—Conference on "Town Planning, Housing and Full Employment".

Tuesday, July 6

ROYAL SOCIETY OF MEDICINE (at 1 Wimpole Street, London, W.1), at 5 p.m.—Annual Meeting.

Friday, July 9

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Dr. R. O. Redman: "Spectrographic Observations of the Total Eclipse of 1940 October 1; 3: The Spectrum of the Extreme Limb of the Sun"; Dr. R. v. d. R. Woolley: "Note on Convection in the Sun"; Mr. A. W. J. Cousins: "Photo-visual Magnitudes of Southern Stars".

INSTITUTE OF PHYSICS (JOINT MEETING WITH THE INSTITUTION OF ELECTRONICS) (in the Reynolds Hall, College of Technology, Sackville Street, Manchester), at 7 p.m.—Dr. A. Sommer: "Photo-electric Cells".

Saturday, July 10

INSTITUTE OF PHYSICS (INDUSTRIAL RADIOLOGY GROUP) (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 2.30 p.m.—Open Discussion on Industrial Radiology.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ASSISTANT MISTRESS WITH HOUSEHOLD AND SOCIAL SCIENCE QUALIFICATIONS, INCLUDING BIOLOGY AND HYGIENE—The Clerk to the Governors, Mid-Essex Technical College, Chelmsford (July 7).

LECTURER IN BUILDING CONSTRUCTION, GEOMETRY AND SCIENCE, AND ELEMENTARY MECHANICS in the Junior Building School of the Newport Technical College—The Director of Education, Education Offices, Charles Street, Newport, Mon. (July 7).

ASSISTANT MASTERS FOR (*a*) MATHEMATICS, (*b*) SCIENCE, INCLUDI BIOLOGY, (*c*) ADVANCED MECHANICAL ENGINEERING SUBJECTS, ENGINEERING SUBJECTS INCLUDING ELECTRICAL ENGINEERING A WORKSHOP TECHNOLOGY—The Principal, Enfield Technical Colle Queensway, Enfield, Middlesex (July 9).

ASSISTANT MASTER IN THE JUNIOR TECHNICAL SCHOOL, WE QUALIFIED TO TEACH MATHEMATICS AND SCIENCE—The Princip Royal Technical College, Peel Park, Salford 5 (July 9).

TEACHER (TEMPORARY) OF SCIENCE AND MATHEMATICS, and TEACHER (TEMPORARY) OF WORKSHOP PRACTICAL (ENGINEERING) A TECHNICAL DRAWING—The Principal, Stockport College for Furt Education, Stockport (July 10).

JUNIOR LECTURER AND DEMONSTRATOR IN THE DEPARTMENT MECHANICAL ENGINEERING—The Registrar, The University, Liverpo (July 14).

DEMONSTRATOR (MAN OR WOMAN) IN THE PHYSIOLOGY DEPARTME —The Warden and Secretary, London (Royal Free Hospital) Sch of Medicine for Women, 8 Hunter Street, London, W.C.1 (July 16).

COMBINED POST OF FULL-TIME (ACTING) RADIOTHERAPIST TO T LIVERPOOL CANCER CONTROL ORGANIZATION and (ACTING) MEDIC DIRECTOR OF THE RADIOTHERAPEUTIC DEPARTMENT OF THE LIVERPO RADIUM INSTITUTE—The Hon. Secretary, Liverpool Cancer Cont Organization, 66 Rodney Street, Liverpool 1 (July 24).

HEADS OF THE DEPARTMENTS OF PHYSIOLOGY, MEDICINE, A SURGERY—The Bursar, Royal Veterinary College and Hospital, The University, Reading (October 1).

PSYCHIATRIC SOCIAL WORKER—The Medical Superintenden Springfield Mental Hospital, Tooting, London, S.W.17.

TEACHERS (MEN OR WOMEN) FOR THE FOLLOWING SUBJECTS FOR T DAY SCHOOL: JUNIOR MATHEMATICS; MATHEMATICS; GEOGRAPHY GENERAL SCIENCE—The Clerk to the Governors, South-West Ess Technical College and School of Art, Forest Road, Walthamsto London, E.17.

TEACHER OF ENGINEERING SUBJECTS—The Principal, Technic Institute and Day Technical School for Boys, Gravesend.

SCIENCE MASTER TO TEACH MAINLY BIOLOGY in connexion with Pre-Agricultural Course for Boys in the Maidstone Technical Institu —The District Secretary, Mr. A. W. Peacock, 13 Tonbridge Roa Maidstone.

CENTRAL PRODUCTION ENGINEER—The Ministry of Labour an National Service, Central (Technical and Scientific) Register (Referen No. C.1609X), Alexandra House, Kingsway, London, W.C.2.

ENGINEER (temporary staff) for the Nigerian Government Publ Works Department—The Ministry of Labour and National Servic Central (Technical and Scientific) Register (Reference E.684, Alexandra House, Kingsway, London, W.C.2.

REPORTS and other PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Philosophical Transactions of the Royal Society of London. Serie A: Mathematical and Physical Sciences. Vol. 239, No. 806: Th Negative Ions of Atomic and Molecular Oxygen. By D. R. Bate and H. S. W. Massey. Pp. 269–304. (London: Cambridge Universit Press.) 5*s*. 6*d*. [31

Association of Special Libraries and Information Bureaux. ASLI War-time Guides to British Sources of Specialised Information, No 5: Engineering, other than Electrical. Pp. ii+38. (London: Association of Special Libraries and Information Bureaux.) 5*s*.; to non members, 6*s*. [31

University of London. Report of the Acting Principal on the Wor of the University during the Year 1942–43. Pp. 8. (London: University of London.) [315

Institute of Welding: Welding Research Council. Memorandu on Deep Penetration Fillet Welding. Prepared by the R.49 Sub Committee on Arc Welding Procedure for Shipbuilding. (T.11.) Pp. 4. (London: Institute of Welding.) [16

Medical Research Council. War Memorandum No. 2: Notes on Gas Gangrene; Prevention, Diagnosis, Treatment. With an Account of the Technique of Wound-Excision and a Scheme for the Bacteriological Investigation of War Wounds. By the War Wounds Committee of the Medical Research Council and the Committee of London Sector Pathologists. Revised second edition. Pp. 28. (London: H.M. Stationery Office.) 6*d*. net. [26

Other Countries

Proceedings of the United States National Museum. Vol. 93, No. 3162: A New Pest of Albizzia in the District of Columbia (Lepidoptera: Glyphipterygidae). By J. F. Gates Clarke. Pp. 205–208+plates 21–25. (Washington, D.C.: Government Printing Office.) [36

Carnegie Institution of Washington. Year Book No. 41, July 1, 1941—June 30, 1942; with Administrative Reports through December 18, 1942. Pp. xxxii+9+309. (Washington, D.C.: Smithsonian Institution.) [86

Annals of the New York Academy of Sciences. Vol. 43, Art. 6: Protein Hormones of the Pituitary Body. By H. B. van Dyke, Bacon F. Chow, Vincent du Vigneaud, H. L. Fevold, George W. Irving, Jr., C. N. H. Long, Theodore Shedlovsky and Abraham White. Pp. 253–426. (New York: New York Academy of Sciences.) [86

Indian Forest Records (New Series). Entomology, Vol. 7, No. 4: Immature Stages of Indian Lepidoptera (4) Zygaenidae. By J. C. M. Gardner. Pp. ii+155–162+1 plate. (Delhi: Manager of Publications.) 7 annas; 8*d*. [86

Indian Forest Bulletin No. 117: The Testing of Packing-Cases and some Suggested Improvements in the Design of such Boxes. By V. D. Limaye. Pp. 11. (Dehra Dun: Forest Research Institute.) [86

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CO-OPERATION IN SCIENTIFIC RESEARCH IN THE BRITISH EMPIRE

A FEATURE of the discussions at the conference on the Planning of Science arranged by the Association of Scientific Workers last January was the constant reference to the need for closer inter-Allied co-operation, and in particular to the need for extending the arrangements by which young workers from the war laboratories may visit their colleagues in other countries, not merely for discussion but also to work side by side in allied teams. The value of fostering contacts between workers in the universities, in industry, and in Government departments, and of frequent exchange of staff as well as of information, was clearly recognized, and was afterwards reiterated by Dr. P. Dunsheath in a paper before the Royal Society of Arts. Similarly, the importance of establishing a central information bureau from which such scientific and technical liaison could be conducted as to ensure that departmental missions are at least in touch with one another, and that those at the centre know what all, and not just a few, of the various departments are doing, no longer appears to be in dispute.

Specific recommendations have now been made in a report of the British Commonwealth Science Committee set up under the chairmanship of the president of the Royal Society in October 1941 as the outcome of a conference held at the Royal Society's rooms on October 7, 1941. This conference included representatives of the Dominions and India, and of the Royal Society ; and the secretaries of the Medical and Agricultural Research Councils and the secretary of the Department of Scientific and Industrial Research, Lord Hankey and others were invited. The general objectives were to secure scientific co-operation in tackling the emergency problems of the immediate post-war period and to ensure that the most should be made of our common scientific resources after the War for improving both scientific knowledge itself and the life of the peoples of the Empire ; in particular, the conference was to consider means of promoting co-operation between the several parts of the Empire in scientific research and in the application of science to technical, biological, medical and economic problems.

The report now issued summarizes the discussions at the twelve meetings of the Committee. These discussions have been focused mainly on schemes for collecting and disseminating information, for example, on the model of the Imperial Agricultural Bureaux ; schemes for collaboration in research within the Empire ; and schemes for facilitating visits and readier movement of research workers, university teachers and others within the Empire. The extension of such schemes to collaboration with the United States has also been discussed. The Committee has aimed at discovering, so far as possible, what is lacking in the existing machinery, and it stresses that the implications of the Atlantic Charter point inevitably to the need for closer political, social and technical collaboration with the United States, the U.S.S.R., China and other countries or regions. Planning collaboration in well-defined spheres of activity is a pressing need, first through the establishment of the best agreed co-operative machinery for exchange and dissemination of technical information and later by planning for co-operative research on problems common to all or to certain regions.

As an example of such a regional scheme, the report cites Brigadier B. F. J. Schonland's suggestion that institutes for research on African problems might be formed in such subjects as tropical diseases, social anthropology, native languages, ethnology, geology, geophysics and meteorology. Many important problems of world-wide significance are being investigated independently in Empire countries and elsewhere, and the advantage which would result from co-operation between those countries willing to pool resources for the common good need scarcely be stressed. The Colonial Research Committee recently established under Lord Hailey's chairmanship should facilitate such co-operation, and the researches which may be undertaken by the Committee should also be co-ordinated with work in the Dominions and elsewhere.

It is unnecessary to reiterate here the examples cited in the report of fields in which such co-operation is called for and is related to programmes of post-war reconstruction, or to enumerate the various international organs already in existence, such as the International Locust Research Committee, the World Power Conference, and the International Institute of Agriculture. Proposals for the re-organization of some of these, for example, the International Health Organisation, were already under consideration at the outbreak of the War, and most of these services will need reviewing and probably revising in the most suitable form and on as wide an international basis as possible after the War. For the re-establishment of such co-operation Anglo-American initiative may indeed be essential, and further consideration will have to be given to machinery for close collaboration in research and the establishment of laboratories and institutes common to the Empire and the world.

On this question the report therefore makes three specific recommendations. First, that a suggestion be made to the Governments of the various English-speaking countries that they should consider the possibility of maintaining permanent scientific and technical representation in London and possibly also in other capital cities of the English-speaking world. Secondly, that such scientific and technical representatives of the Dominions and India permanently established in London should, together with official representatives of science in the United Kingdom and the Colonies, be constituted a British Commonwealth Scientific Collaboration Committee, to act with the Royal Society in the discussion of topics of common interest, to keep in touch with all agencies and organizations for the collection and dissemination of scientific information, to further schemes for co-operation in research, and to make such recommendations and proposals for common action as may seem fit. Thirdly, that if scientific and technical representatives of the United States and of othe countries outside the British Commonwealth ar established in London, arrangements should be mad to seek their co-operation, so far as may be practicabl and appropriate.

The wisdom of this last recommendation is so paten that the support of all scientific workers is assured The report itself indicates that the New Zealan Council for Scientific and Industrial Research, th National Research Council of Canada and the Nationa Research Board of South Africa are already prepare to support such collaboration. Scientific workers, however, should demonstrate emphatically their support both through their professional associations, and also in their private capacity as individual citizens, so that the Government can be in no doubt as to the extent of the support which is forthcoming for the proposal. There should be no ground for any pretence that the recommendations are in advance of what scientific workers as a body are prepared to endorse and wholeheartedly to implement.

The first of the six recommendations of the report, however, is one which makes even stronger demands for immediate support and response from scientific workers. There are, as the report points out, a number of bodies collecting and disseminating scientific information which might be assisted if made part of a wider scheme, and in particular, collaboration in the production of scientific abstracts of high quality for the common use of the English-speaking world would have the strong support of the Committee. In accordance with this, the Committee recommends that the Royal Society should invite representatives of the appropriate scientific, technical and official bodies to meet as early as possible this year to discuss in general the further development of abstracting and information services as a co-operative effort between English-speaking countries, and, if agreed, to propose machinery for making a more detailed inquiry and for formulating more definite plans.

The report touches here on a demonstrable weakness in the organization of science. Besides the overlap between *British Chemical and Physiological Abstracts* and *Chemical Abstracts* and *Science Abstracts*, there are numerous examples of overlap and duplication in more limited fields, such as analytical chemistry and particular industries, which are hard to defend to-day against the charge of extravagant use of labour and material. That this is now being more widely appreciated is indicated in an inquiry, sent out almost simultaneously with the publication of this report, to members of the Society of Dyers and Colourists, asking for an indication as to whether or not members would be prepared to dispense with the abstracts which are at present included in the *Journal* of that Society. Further opportunities for rationalization in a comprehensive scheme are clearly to be found in the abstracting services and publications of research associations and similar institutions, although here are to be found one or two examples of the effective elimination of duplicate effort. In the medical and biological sciences the position is much worse, and there are really wide opportunities of eliminating duplication of effort even within the limits of Great Britain.

There can be little doubt that rationalization in this field will be best secured under some comprehensive scheme covering all the sciences. Such a scheme will have the best chance of dealing with the difficulties in regard to nomenclature, bibliographic detail and the like which are apt to be a source of friction in smaller schemes when co-operation between allied sciences is involved. Moreover, under a large scheme, the savings to be achieved by genuine rationalization should make it unnecessary to continue some of the abbreviation practices to which some abstracting organizations have been forced in recent years owing to lack of resources. Such practices have been a minor source of irritation to many of the present users of such abstracts, and they offer a real obstacle to the wider use of the abstracts in their present form. Again, a central scheme is far better placed to encourage the use of new means for the rapid dissemination of information, such as microfilm, and to explore the possibilities of such developments.

The report shows that the Royal Society's committee is fully alive to the possibilities and to the need for rationalization of effort in the provision of an efficient and widespread information service. By extending, for example, to cover a wider field, the principle of the Imperial Agricultural Bureaux, which are maintained by a central organization, though working in separate institutes, greater financial stability, prevention of duplication and a closer co-ordination of the whole information service should be achieved. Rationalization of existing British organizations throughout the Empire should only be regarded as the first step. Scientific research and technical development have a fundamental bearing on economic factors, and the organization in each country for the collection and correlation of scientific information should be such that it would aid the collection of data by the economic bureaux.

The Committee is clearly right in holding that this whole issue must be the subject of detailed inquiry before any definite proposals are put forward. None the less, while such inquiry is proceeding, scientific workers could do much to prepare the way and to overcome the prejudices and other obstacles which have rendered abortive earlier and more limited efforts in this field. The growing complexity of science and technology, and the penetration of science into almost all human activities, make it essential that every effort should be made to provide as efficient an information service as possible ; this is no longer a matter which concerns scientific workers alone.

If rapid progress can scarcely be looked for in the matter of this first recommendation, the situation is entirely different in regard to the last two recommendations of the report. There appears to be no good reason why immediate steps should not be taken to direct the attention of the Governments concerned and of independent agencies to the very great value of frequent and easy personal contacts and exchanges between research workers and students in various countries, which air transport should greatly facilitate in the future. For this purpose, largely increased funds would be required, and some plan for co-ordination would require working out with the various grant-giving bodies.

Similarly, there should be no delay in pointing out to the various Governments, universities and other authorities the advantages which would result from the institution of a system of sabbatical leave, to enable the scientific and technical staffs of academic, Government and industrial research organizations to make fuller use of such facilities as may, from time to time, be available for visits to other parts of the English-speaking world. In the whole of its remarks on this question of the flow of personnel, the report shows that the Committee is fully abreast of the most progressive thought in science and in industry. Here, as elsewhere, the report gives a clear lead to all scientific workers who wish to see science making a fuller contribution both to the war effort and to the task of post-war reconstruction. On them now rests the responsibility of seeing that that lead is followed, and that their existing organizations and societies do all that is possible to secure and support the necessary action required to implement the recommendations.

IMPACT OF SOCIAL INFLUENCES UPON ART

The Psychology of Cultural Change in Painting
By Dr. R. W. Pickford. (British Journal of Psychology, Monograph Supplements, 26.) Pp. vi+62. (Cambridge : At the University Press, 1943.) 8*s*. 6*d*. net.

NO painter can avoid some degree of self-expression ; he may introduce a large amount of it, but in any event he is unlikely to be utterly objective. Whatever his choice of subject and treatment, his composition will be psychologically significant. What is perhaps even more important is that he has expended energy in the making of his picture and, through strife and toil, has arrived at something which, by highly complex paths, represents at last a function of his social environment. Thus, in the introduction to his monograph, Dr. R. W. Pickford paves the way for the detailed development of his theme. He is concerned neither with techniques nor with æsthetics ; his task is to discuss social influences in their impact upon artists. In so doing, he performs a double service—to the man of science who realizes the profundity of all that is involved in creativeness (in whatever form), and to the historian, who is sometimes curiously reluctant to see in paintings the documents he most may need.

Naturally, this is scarcely a contribution for the layman. It is a closely woven pattern, cautious in the intertwining of warp and woof. However, one criticism the non-initiated might be tempted to make, and it may be worth while to anticipate it now. He would assert, in effect, that all this close analysis only amounts to what anybody with but a modicum of common sense would surmise in less time than that taken to say Jack Robinson. Examples are the effects upon leaders of those whom they lead, of frustration and of thwarted purpose, and so on. But in this he would be mistaken. A superficial interpretation of the nature of genius is usually rash, and there is a world of difference between riding roughshod over the minutiæ of circumstance inherent in some artistic or intellectual upheaval, and the enviable clarity of exposition, step by step, which is a feature of Dr. Pickford's approach.

A reasonable distinction can assuredly be drawn between a study of groups and individuals on one hand, and the psychology of cultural change on the other. This dichotomy serves well in the present instance, dividing the whole monograph into two approximately equal parts. Furthermore, it is easier for the reader to be introduced to the personalities crossing the stage before being asked to pass judgment upon the setting or settings which in fact contained them. The result is a very human assessment of the whole problem, or, as the author would call it, "comradely". The reviewer wishes, however, that examples from the West somewhat earlier than the French masters could have been discussed; for example, the Italian primitives and the Flemish painters. Certainly group tendencies as well as directional inhibitions were strong in both these movements. The point seems to emerge that it is just as advantageous (to put it mildly) in psychological research to take the simplest case as material upon which to work as it is in the more exact sciences. Of course, it is far from universally true that simpleness—not necessarily simplicity—of technique connotes the simple mind, but it was probably so in, say, Siena in the fourteenth century, thus providing a good springboard from which to attack later complexities.

The analysis of Chardin, Goya, Daumier and Cézanne is most illuminating. Dr. Pickford is thus led to discuss ambivalence, the characteristic possessed by some people of displaying acceptance and rejection of the same situation either alternately or simultaneously. Apparently this did not afflict the first two of these artists, but was strong in Daumier and terrific in Cézanne. When present, it is clear that severe mental conflicts will arise. It is significant how similar in some ways these dispositions are to the transitional properties frequently observed in physics and chemistry. The parallel must not, however, be pressed too far, for whereas we have recently learnt (for example, in crystallography) how to insert missing members into a series, if Nature is not kind enough to provide them, we cannot yet do this for human material. Until we can, our results will often be patchy, though with the vast amount of 'stuff' available, it is presumably worth combing very thoroughly in attempts to fill the gaps.

The Barbizon painters represent a small nexus of men, compact and bourgeois, very susceptible to natural scenery and to the appeal of tranquillity. Whence comes this latter characteristic ? It is hard to say, but perhaps permissible to mention that such a totally different person as John Keble was writing of the 'soothing' element at very closely the same moment in the first edition of his "Christian Year". Corot appears as the undisputed leader of the group. He possessed qualities amounting to greatness, both as a painter and as a man. Millet, who always enjoyed considerable popularity in Great Britain, was obviously influenced by the Italian primitives. Both for the Barbizons, and for the Pre-Raphaelites (to be discussed later), it seems that a forceful literary critic was needed to make the work of psychological groups fully effective. This was achieved for the former by Thoré, and for the latter by Ruskin. At this distance of time, it is easy to underrate how much these two writers did for their causes. Another condition for effectiveness is the presence—in some form or another—of interpreters, who, as Dr. Pickford remarks, resemble stepping-stones to conduct the public to the great masters themselves. This was done admirably by the lesser lights of the Barbizon school.

Perhaps it is as well to recollect what a very specialized study this cultural change in painting is. Unlike other means of approach, it is competent to offer suggestions for an evaluation of kindred problems by comparative methods. To-day, for example, we are being pressed for an enhanced publicity campaign in the interests of science. It is hard to avoid the conclusion that history is but repeating itself. Once again the question is: "How can they hear without a preacher ?" Stepping-stones of one kind or another will apparently always be needed if the creativeness of supreme minds is not to become sterile, and their contributions unheeded. What the Barbizon group in particular has to teach is that this widening of influence is possible without disturbance of genius at the top. But the balance is a delicate one. Corot was a great enough personality to appreciate the necessity for diffusion, but to maintain inviolate the fountain-head.

We are thus invited to examine the Barbizon's group structure. A most intriguing short paragraph on p. 14 almost implies—though it does not exactly say so—that its character was that of a *Gestalt*. Admirers of Wertheimer will be quick to notice a parallel between Dr. Pickford's pattern of these men and his "celestial orchestra" in which, as Koffka remarks, little would be gained by restricting attention to the part played by each angel. Important, indeed essential, as every performer is, the meaning of the work resides in its 'wholeness', that is, in its *Gestalt* character. That this is, broadly, the direction of thought seems probable from a remark (p. 46) on stable configurations, and their part in conservation. Clearly, there is something akin to Le Chatelier's principle in physical chemistry in operation here.

Rousseau's personality—as a "Barbizon", and as an individual—is of great interest. He was given to excessive repainting of detail. In acting thus, he expends much labour without reducing the free-energy of his picture appreciably: for a given organization he may even deviate from the minimum, thus increasing the 'potential' and diminishing his approach to satisfaction and repose. So far as the present reviewer is aware, a Rousseau has never been X-rayed. Occasionally, by these means, objective proof is obtained of the way in which artists—not infrequently with disastrous results—have modified and remodified details.

We now approach a major development, the advent of the Pre-Raphaelite Brotherhood. Because its activities ultimately degenerated into being 'just too arty-crafty', it is an error to overlook its originally serious purpose. Dr. Pickford has handled this very tangled skein of dispositions and emotions with distinction. Perhaps it is profitless in the present essay to enlarge upon his careful analysis of the leading personalities involved: they were all more or less abnormal, and some of them exceedingly 'difficult'. What is important is the undoubted influence which the whole affair had upon society, and society upon it. Religion, social reform, æsthetics, intellectualism, and even manners were engulfed in the flood generated by Rossetti and his followers. A pathetic figure, somewhat on the periphery, was Swinburne, interpreted for us largely on Freudian principles. For him, however, and for others like him (if such there ever were), the most lethargic of streams will always find sanctuary at last in the wide ocean spaces. Incidentally, it would have been interesting to know the author's views upon the work and life of Lord Leighton. Too late, and perhaps ill-suited, for full-blooded participation in Pre-Raphaelism, his art is clearly conditioned by it in a very complex and obscure way. His place in the contemporary world of affairs made him and his compositions a 'derived function' of some consequence. It has little to do with stylistic questions, being mainly a matter of social environment.

Chapters 5 and 6 take us far afield, to the contemplation of the Mogul miniatures, and of Russian painting, respectively. The psychological types encountered are so entirely different from those met with in the West that the reader experiences a sharp discontinuity at this point. It would be a pity if he thus inclined to follow his guide less closely here : for the sake, however, of avoiding too wide a sweep, it is proposed now to pass on immediately to the second main portion of Dr. Pickford's theme, namely, the psychology of cultural change itself. In this section the Eastern factors have their full part to play, and with increasing knowledge of them it should be possible to discern their great importance in the transmission of cultures.

Three distinctions are made in this process. First, then, is the passing-on of culture from one large group to another, with fairly permanent contact. Secondly, comes borrowing, that is, the impregnation of a large group by a small one bringing its cultural limits with it. Thirdly, appears grafting, which is a special case of borrowing, when there is an element of force on the part of the transmitting agents.

Contact transmission is, on the whole, the most primitive method, as exemplified by the Bushmen of South Africa. When civilization is more advanced, borrowing and grafting are more likely to occur. A good example of the former is the way in which English landscape influenced the French masters immediately before the Barbizon school. It is well, however, to avoid the conclusion that borrowing alone will suffice to set a cultural change in motion : a more profound impulse such as social constructiveness is probably essential. In this way, borrowing is somewhat catalytic ; experience shows that, as in chemistry, the catalyst may become poisoned, and the reaction comes to a stop.

A question discussed at length is that of omission. It seems that there is continuously at work a kind of mental sieve through which new ideas (of all shades of value) are constrained to pass. In this process, many will be filtered out. This sieve-action is much more complex than a mere mechanical selection, and two persons, starting alike but with unequal 'meshes', will embark upon their respective future enterprises on entirely different lines. The psychology of what is thus rejected—and, therefore, of what is left—is of great interest. There are various possibilities. One is that group tendencies rather than individual ones will predominate. Mogul painting illustrates this, and the same is true to some extent of the history of the Russian ikon. An example of personal omission, on the other hand, is that of Rossetti, who at once had no use for the mystical and poetical ideas about Dante which characterized his father.

The author makes an illuminating comment upon the decay to which, in general, cultures are subject. Decline he believes to be but "the result of very great adversity to construction".

In a review of reasonable length, it has only been feasible to notice a small proportion of the points made by Dr. Pickford. There are many others which will stimulate thought and inquiry from all the diverse interests concerned. What stands out above them all is the insistence upon meaning or significance in painting, as illustrated by cultural change. This transcends mere explanation, and is thus in harmony with modern thought in other directions. It is very much to the good that this movement should gain impetus in one of the most highly developed of the fine arts. The author has produced a scholarly design, seen to advantage against a background at once warm and magnanimous. F. Ian G. Rawlins.

COPERNICUS

Nicholas Copernicus (Mikołaj Kopernik), 1473–1543

Prepared by Dr. Józef Rudnicki. Translated from the Polish by B. W. A. Massey. Pp. viii+53+25 plates. (London : Copernicus Quatercentenary Celebration Committee, 1943.) 10*s*. net.

THE work of Copernicus, whose centenary we have been commemorating, was not limited to astronomy, though to most people he is known only by his astronomical work. The publication under notice surveys briefly his activities. He possessed some artistic skill, and among his manuscript remains is one showing that he dabbled in poetry. This is a religious narrative poem, "Septem sidera", describing the life of Christ up to the time of his converse with the teachers in the Temple. He obtained proficiency in languages also, and published a translation from Greek into Latin of the poems of Theophylactus Simocatta. His work on economics was of considerable importance, and it should be remembered that he formulated Gresham's Law, that bad money, if recognized as legal tender, will drive out good. He also showed the necessity for the ratio of value between gold and silver coins to depend on that between the metals. During the hostilities with the Teutonic Knights in 1521, when he was administrator of the capitulary estates at Olsztyn, he was the only one of the canons who remained at his post, and later the king rewarded him with the title of "Commissary of Warmia" for his work.

All these and other activities besides seem insignificant now in comparison with his revolutionary work in astronomy, which exercised a profound influence in human thought. Perhaps his name would have been almost unknown in history and his *magnum opus* have rested forgotten on the shelves of a monastery library if it had not been for the influence of Rheticus, a young mathematician from Wittenberg. He procured the publication of Chapters 12–14 of "De Revolutionibus", which were included in Copernicus's "Trigonometry", and the issue of the whole work seemed an attractive financial proposition to J. Petreius, the Nuremberg bookseller. As, however, the book appeared very revolutionary in character, a piece of fraud was perpetrated by Andrew Ossiander, the editor, who was a Lutheran preacher interested in astronomy. He replaced Copernicus's original preface, unknown to Copernicus, by an anonymous one of his own, and in this the conclusions of the work were presented as mere hypotheses, without any basis in reality. Unfortunately, a widespread belief that Copernicus had advanced his theory merely as a mathematical device prevailed as a result of this forgery, and Copernicus did not live to correct the error.

The general acceptance of the heliocentric theory was retarded for various reasons. It was claimed that an astronomical system would fit in equally well with observed phenomena if a geocentric view were adopted. Then certain implications of the new theory seemed contrary to the doctrine of the Church, which was prepared to enforce its own views by severe methods, as shown by the fate of Bruno and Galileo. Finally, after the Swedish forces of Gustavus Adolphus had occupied Polish Prussia and Warmia in 1626, Copernicus's books and various documents relating to his life were carried off to Stockholm and Uppsala. There they remained forgotten until the Polish scholar Birkenmajer rediscovered them about the beginning of the present century. In spite of these obstacles the truths first propounded by Copernicus paved the way for those great and far-reaching discoveries which were accomplished by his successors.

THE LIFE-HISTORY OF A PUEBLO INDIAN

Sun Chief

The Autobiography of a Hopi Indian. Edited by Leo W. Simmons. (Published for the Institute of Human Relations.) Pp. xi+460+5 plates. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1942.) 26*s*. 6*d*. net.

THIS book—the story of a Hopi Indian from Arizona—forms an interesting sequel to its predecessor in the same series, which was a similar account of a Kwakiutl Indian from Vancouver Island. In both cases the period covered is one of conflicting cultures—Indian and white—beginning whilst the Indian customs are still holding sway but gradually weakening as the white influence becomes stronger. The cultural setting of the two tribes is quite different, and a good deal of interest is added if both autobiographies are studied.

Don C. Talayesva, the subject of this study, was born in 1890 at Oraibi, a Pueblo village perched on a 6,500-ft. plateau, in constant occupation by the Hopi for at least eight hundred years. In spite of outside influence the Hopi retained their own individuality, both cultural and racial, longer than many other tribes, and therefore provided good material for investigation. Living as they do in a sandy and arid region, water has always been a problem and many of their ceremonies are concerned with making rain and ensuring good harvests, for upon these the Hopi depend for their living. They are a peace-loving, hard-working tribe, but when attacked they defended their mesa-top fiercely and successfully. Conditions of life made transport a never-ending labour, as all food and fuel and most of the water had to be hauled to the mesa top, and all able-bodied members of the tribe took their turn at this task. There is no supreme chief of the Hopi, each Pueblo is independent and the authority, mainly theocratic, is invested in a council of hereditary clan chiefs. Each Pueblo is also organized into exogamous matrilineal clans and every male is a member of a Kiva group, which is a ceremonial organization.

The background, therefore, of Don's life was of an assured and well-defined pattern, and it is all the more interesting to see the results of the impact on him of white culture. For the first ten years he lived with his tribe and the book gives his own detailed and extremely interesting account of a boy's life from his birth. Very notable is the link between him and his maternal grandfather, who took great pains with his education, both material and spiritual. This fine old man roused the boy before sunrise to bathe and exercise and do useful work for, as he used to say, "Work means life".

According to his own account Don was a high spirited and mischievous boy for whom ordinary discipline seemed useless. Accordingly his initiation at nine years of age was made extra severe, and the double whipping he received seemed to have a salutary effect. Next year he went to the reservation school to begin his education, which continued until he was eighteen. By this time, as he says, he had learned to "talk like a gentleman, read, write and cipher", work at various trades and "get along with white men". During his last year at school he had a serious illness which he attributes to Hopi witchcraft and during which, as he still maintains, he died and went to the Hopi spirit world in the west. Here he was cautioned by his guardian spirit and allowed to return to life on condition he behaved well in future.

On his return to Hopiland Don renounced his superficial Christian beliefs and resumed his Indian status, taking part in the rituals and ceremonies and marrying a Hopi girl from a suitable clan. He was still troubled by witchcraft, however, and had various illnesses which he attributed to it, as also the loss of each of his children in babyhood. This last was a bitter blow, as Don was passionately fond of children and felt very deeply the stigma of being childless. When he had almost given up his hope for a child his wife's sister brought her two-year-old son, who was very ill and whom Don nursed back to health and then adopted, treating him very well, if somewhat indulgently. But the upbringing of this boy was far less rigorous than was that of Don himself forty years previously, and one wonders how far the clash of cultures will affect this new generation.

The autobiography is written for the most part in Don's own words, edited by Leo W. Simmons, who stayed in Orabi with Don and became his blood brother. The original document has been much shortened, but is even so almost wearisomely prolonged; the author mentions that Don's sometimes monotonous accounts of his meals had to be cut down, and one wonders if the constant harping on the gratification of his sexual appetite might not have been similarly treated. The description of the ceremonies is intensely interesting, more especially so as Don believed in them so wholeheartedly and constantly refused to relate anything that was considered secret. In fact, this refusal almost led to his breaking off his narrative, and he was only persuaded to continue by being shown accounts of the ceremonies that were already printed.

The book is divided into three main parts: an introduction which outlines the scheme of procedure and then gives a general account of Hopi life in Orabi. The main portion is, naturally, Don's autobiography, the scope of which is outlined above; whilst in the appendix are an example of situational analysis, some Hopi myths and legends, a guide to kinship, and samples of Don's compositions. There are a few illustrations, and a comprehensive index gives a finish to a valuable if rather lengthy volume.

K. Rishbeth.

Plain Words

A Guide to Sex Education. By W. J. Thomas. Pp. 84+10 plates. (Sydney: F. H. Johnston Publishing Co., 1942.) 2s. 6d.

THIS little book is unfortunately mistitled. Unfortunately, because although it scarcely begins to consider the many difficult and thorny problems of sex education, it does give an excellent outline of the physiological facts of sex and some of their sociological implications. Particularly good for such a modest publication are the ten plates, although they are open to criticism on points of detail.

In the first chapter, on "Sex and Wartime Morality", several important questions are begged. It seems to be assumed, for example, that sexual intercourse in marriage implies love and affection, while outside marriage it is "without love" and therefore "an abomination". This attitude neglects the very vital distinction between extra-marital intercourse which is simply promiscuous, and that which is (as is often the case) based on devotion deep and lasting. Similarly the excellent case against the new eroticism of Nazi Germany is weakened by the citing of such 'evidence' as that "Every popular magazine contains at least two or three nude photographs".

Other criticisms of a like nature may be made, and in particular, the author's discursive and repetitive style is rather irritating. But none of this should be taken to condemn the book. It is excellent in its way, and should be as useful in Great Britain as it no doubt will be in Australia.

CYRIL BIBBY.

German for the Scientist (Chemist and Physicist)

By Peter F. Wiener. Pp. xvi+208. (London: G. Bell and Sons, Ltd., 1943.) 6s. net.

THIS book is intended to enable the science student to acquire a reading knowledge of scientific German in a short time. The essentials of grammar and a basic vocabulary are built around a Hans Andersen story. The bulk of the volume consists of passages for translation, and the author has evidently been at some pains to select material which has scientific interest as well as a bearing on the development of his theme. A person with a little previous knowledge of German will find the reading of this book an excellent means of brushing up grammar and rapidly acquiring the ability to make sense of scientific literature. A complete beginner might find himself in some difficulty without a little outside assistance.

The reader is not pampered by vocabularies in the midst of the German text. The passages are from works on chemistry and physics, but this need not dissuade the student of other subjects, for the material is general and the vocabulary widely applicable. Literal translations of the German passages are appended, and there is a full vocabulary.

Papers of a Pioneer

Sir Pendrill Varrier-Jones. Collected by Peter Fraser. Pp. 107. (London, New York and Melbourne: Hutchinson and Co. (Publishers), Ltd., 1943.) 6s. net.

VARRIER-JONES contributed to various medical journals, reviews and periodicals, a number of lectures, addresses and papers treating of many aspects of tuberculosis. The substance of these has been gathered by Mr. Peter Fraser into a connected narrative.

In the first chapter Varrier-Jones points out that the consumptive's life is a damaged one and that breakdowns and relapses will often occur if he is merely given a course of sanatorium treatment. Frequently, too, the patient remains a source of infection to the community. In the three succeeding chapters the author notes how economic considerations prevent the diagnosis of the early case, that for no class of the disabled is a life "sheltered and yet active, protected and yet self-respecting", so necessary as for the tuberculous, and that the problem is not purely medical. Psychology and sociology are mingled with medical considerations. The remaining chapters of the book describe how the author solved the problem by providing medical supervision, treatment and care in the village settlement at Papworth.

The editor has done his task well. The book will appeal to all workers engaged in combating the ravages of tuberculosis. As Lord Horder remarks in his foreword, there could not be a more sincere memorial to Varrier-Jones and his work.

Changes in the Knee Joint at Various Ages

With Particular Reference to the Nature and Development of Degenerative Joint Disease. By Prof. Granville A. Bennett, Dr. Hans Waine and Prof. Walter Bauer. Pp. ix+97+31 plates. (New York: The Commonwealth Fund; London: Oxford University Press, 1942.) 14s. net.

THIS volume summarizes the results of an investigation into the morphological and histological appearances in the so-called normal knee joint at each decade of life. The anatomical changes are described and illustrated in a very fine selection of photographs. Beyond the second decade, all the joints examined showed changes similar to those found in hypertrophic (osteo-) arthritis. The signs of disease were progressively greater with increase in age. Pathogenesis and etiology of degenerative arthritis are fully considered. The authors conclude that the joint changes they describe are essentially due to a degenerative process of hyaline cartilage, and suggest investigation of the factors governing maturation, maintenance and ageing of the hyaline cartilage.

Apart from the scientific value of the accurate observations and the full review of the literature, this book can be recommended to the clinician as a useful reference on prognosis and treatment in arthritis.

Principles and Practice of Chromatography

By Prof. L. Zechmeister and Dr. L. Cholnoky. Translated from the second and enlarged German edition by A. L. Bacharach and F. A. Robinson. Second impression (corrected and with Supplementary Bibliography). Pp. xv+378. (London: Chapman and Hall, Ltd., 1943.) 25s. net.

THE early need for a second impression of this useful translation has raised the difficult problem of keeping the work up to date under wartime conditions. Apart from minor corrections the main text is unaltered, but there is a classified supplementary bibliography containing some three hundred references to work published between 1938 and 1941. This makes the work as complete as can be expected at the present time.

SCIENCE IN SOUTH-WEST CHINA

II. THE BIOLOGICAL AND SOCIAL SCIENCES

By DR. JOSEPH NEEDHAM, F.R.S.
British Council Cultural Scientific Mission in China

IN the previous article (July 3, p. 9) some account was given of the work being done in the physicochemical sciences by our Chinese colleagues under the difficult conditions in this part of Free China.

Exactly how difficult the conditions are is not easy to describe. The students live in badly overcrowded dormitories, and are severely subject to disease such as tuberculosis. Affections such as trachoma, caused by inadequate washing facilities, etc., are common. But the contrast between the life of the normal scientific worker as lived previously and as lived to-day is even more pronounced. Scientific men and women of great attainments are accommodated in rickety old structures around courtyards that cannot be kept clean. The scale of pay has risen only seven times while the cost of living in Yunnan has risen 103 times. I can only compare it with going to live in sheilings on the coast of Argyllshire on less than £70 a year after having held a post at £1,000 a year with a good flat. It is often hard for men whose names are well known in Europe and America to get enough to eat. How many of us would have been willing to live in such exile rather than under the invader's domination in comparative comfort ?

National Southwestern United University

I turn now to some of the biological work proceeding in and around Kunming. First, in the National Southwestern United University there is a good deal of botany going on under Prof. Ch'ang Ching-Yueh. Cytology is represented by Dr. Wu Su-Hsuen (she was trained at Ann Arbor, Michigan), and plant physiology by Dr. Li Chi-Tong, who is making interesting studies on the cleistogamy of the violet plant. There is a nutritional laboratory under the energetic Dr. Shen Tung, where a new and exceedingly rich source of vitamin C has just been discovered—perhaps the richest known—*Emblica officinalis* ("i-gan"), often described as the Chinese olive, but really belonging to the Euphorbiaceæ. In entomology, under Lin Chung-Lo and Lu Chin-Rjêng, much work is going on on the lac insect, an animal of much economic importance to China. Similarly, a complete key to the caterpillars of Yunnan is nearly ready, with special reference to the pests. A complete key to the Yunnan flora, mostly the work of the late Prof. Wu Yuen-Chen, who died last year from hardships encountered here and from inadequate hospital equipment, is now being prepared for the press by Dr. Chien Cho-Po.

Chinghua Institutes of General Physiology and Plant Pathology

Out at Dragon King Pool there are the Chinghua Institutes of General Physiology and Plant Pathology. The former is under the leadership of Dr. T'ang P'ei-Sung, very well known in America, especially at Chicago and Woods Hole, as a collaborator of Dr. R. W. Gerard. Dr. T'ang's flair for originality and ability in younger men has gathered round him, besides Shen Tung, such men as Dr. Yin Hung-Chang, an expert on plant growth hormones from the California Institute of Technology, and Dr. Lou Ch'êng-Hou, a biophysicist who is studying electric responses of plants. It was a remarkable thing t see a complete laboratory for the assay of plan growth substances in these primitive conditions. D T'ang's group is also interested in the mechanims c subterranean fruiting in the peanut, *Arachis hypogeum* a subject again of economic importance for China They have made an extensive series of studies, too on the metabolism and physiology of the silkworm on the streaming of plant protoplasm, and on th production of polyploids. Stimulated by the practica problems confronting Chinese science, Dr. T'ang ha written a book of essays, which it is hoped may b published either in England or America.

The other Chinghua Institute, that of Plan Pathology, is presided over by Dr. Tai Fang-Lan Here all kinds of interesting things also are going on Taxonomy of mushrooms (Chiu Wei-Fan) ; nematode carriers of wheat blight (Yu Ta-Fu) ; genetics o resistance to bean wilt and wheat rust (Fang Chung-Ta) ; morphology of aquatic fungi (Shen Shan-Chong) ; and an extraordinary system of symbiosis or cross-stimulus between certain termites and a certain fungus (Chou Chia-Chih).

The number of papers in manuscript which this Institute and others have accumulated in the past two years is considerable. The fact that scientific papers cannot be adequately printed in China, and the fact that the ordinary mails, owing to censorship and other difficulties, are not such as to encourage scientific men to entrust their manuscripts to them, constitute a menace to the morale of our Chinese colleagues. It is therefore the policy of the British Scientific Mission to facilitate the passage of meritorious papers to Britain and America, for publication in our own scientific journals, until those of China can be got on their feet again.

Drug Research Institute

Not far from the Chinghua institutes, in the same part of the country, is the Drug Research Institute of the Ministry of Education, directed by Dr. Ch'ing Li-Pin. Here special attention is devoted to the botany and pharmaceutics of the indigenous Chinese drugs. This Institute is housed in an old village Buddhist temple, in the main hall of which a gigantic Kuan-Yin image looks down approvingly at the indexed collections of dried plants, the numerous editions of the "Pên Tsao" (the classical Chinese pharmacopœia), and the small printing-press on which a bulletin containing descriptions of new plant species is prepared, and some numbers of which have already been sent to Kew.

Dr. Ch'ing Li-Pin is also the director of the physiological section of the Peiping Academy, together with the zoological section (director, Dr. Chang Hsi), on the shores of the great lake in the Kunming plain. The latter possesses a good working library. Investigations on the plankton of the lake are proceeding (Liu Yung-Pin), on the diseases of the edible fishes of the lake, and on the mollusc Margaria, an edible viviparous gastropod which is very abundant in this region.

National Epidemics Prevention Bureau

In another part of the Kunming area is the National Epidemics Prevention Bureau, under the directorship of one of China's most able bacteriologists, Dr. T'ang Fei-Fên, assisted by Dr. Wang Yo-Wei and a large staff. Here last year five million doses of typhoid inoculation were produced. The Institute also makes smallpox lymph, diphtheria and tetanus toxoid, and a good many other things, including diagnostic antigens such as the Widal test serum for typhus, and the Kahn antigen for syphilis. Preparations are under way for producing typhus vaccine. Dr. T'ang is well known to bacteriologists, immunologists and tropical disease specialists in England and America. His plant maintains high standards of cleanliness in the stables and animal houses in spite of the lack of any running water supply, and an extremely efficient system in the growing, bottling and testing departments. Particularly interesting is the fact that the plant includes a complete glass factory, where neutral glass is made from the proximate ingredients and worked into ampoules and capillaries. The glassworks also produce flasks of all shapes, tubing, condensers, beakers, etc. The story of the plant is an epic in itself. For many months the only available boiler was one which was leaky and unsafe, requiring repairs every evening after use, and with this all the sterilizing apparatus, distilled water supply, etc., had to be run; fortunately no accident took place. Typical of the Institute's pertinacity is the re-utilization of agar by a method specially devised. Dialysis took place from a raft in the lake until the depredations of fishes became too great, and a dialysis tank had to be rigged up on land out of the very few materials available. When commercial supplies of proteolytic enzymes ran out, a hog colony was started, and when the condition of the beasts became such as to yield but poor pepsin, the hogs were fattened by special feeding. This, however, is extremely costly, as indeed is the feeding of all the animals, which has reduced the number of horses, for example, considerably. The Institute is now supplying sera for other United Nations troops as well as Chinese, in the East.

National Provincial University of Yunnan

Within the city of Kunming itself is the National Provincial University of Yunnan, occupying a beautiful site and some of the antique buildings of the old Imperial Examination Halls. It has suffered heavily by bombing, having lost its whole chemistry building. Most of the staff are French-speaking, owing to the former French cultural influence in Yunnan. Thus Prof. Chao Yin-Lai, the organic chemist, is a former collaborator of Prof. Grignard. The courses in the medical school, small but neat, are still all in French. The president, Dr. Hsiung Ch'ing-Lai, is an able mathematician, also French-speaking. Among the heads of departments, however, is Mrs. Tsui Chi-Lan, a morphologist who had her training in Germany. She is now occupied with detailed anatomical studies on the origin of the olfactory organs in Amphibia, preliminary to experimental work on the same subject. She is a pupil of Kraus, Spemann and Hartmann.

The University of Yunnan is at present quite strong in the social sciences, having on its staff Dr. Wang Kan-Yu (a pupil of Prof. Ernest Barker) and especially Dr. Fei Hsiao-Tung, widely known as one of Prof. B. Malinowski's most brilliant students, and for his book on village life in China. Dr. Fei's institute is the Yunnan-Yenching Institute of Sociological and Anthropological Research. It is situated in a small town some hours away from Kunming, occupying rather unusual quarters, namely, a fine old tower or pagoda, dedicated to K'uei-Ko (the god of literature), and placed there because one of the townspeople long ago attained to the dignity of being a Hanlin scholar. The top floor, which contains the image of the god, houses part of the library, and the floor below is the main working-room. The Institute has recently published a number of valuable monographs. Dr. Hsu Lang-Kuang, Dr. Fei's chief colleague, has written on the introduction of modern medicine into a primitive community on the western borders of China, a study which necessitated close observation by him of a cholera epidemic. Like old Nicholas Culpepper in Kipling's story, "A Doctor of Medicine", it seems that the people carry out a number of hygienic measures for quite wrong theoretical reasons, but at the same time have recourse to Taoist and other magic. Other colleagues have written on labour conditions in Yunnan, and on the different types of rural economy in the province.

Chinghua Institute of Statistics and Census Research

In a different part of the same town, there is another of the Chinghua institutes, that of Statistics and Census Research. Headed by Dr. Chen Ta, ably assisted by Dr. Tai Shih-Kuang, this institute carries out experimental censuses of selected regions, observing the reactions of the peasants, checking up on various sources of error, and seeing how best to accustom the Chinese country people to a process which must in due course take place. The Institute is housed in a Confucian temple. An imposing succession of 'pailous' and gates leads into the main court, with its raised platform shaded by a few tall old pine-trees. Within the shrine, in true Confucian puritanism, there is only the golden tablet of the sage, surrounded by those of his disciples, among which those of Mencius and Chu Hsi can be distinguished. Below are the calculating machines and card indexes of the statisticians. It is felt that Confucius would be very pleased to see his house so used in the service of the teeming people of whom he said "First feed them, then educate them".

Confucius, like so many of us to-day, was concerned with problems of government. The proper relation of science to government is a problem which has scarcely yet been solved in Britain or America, still less, therefore, has it been solved in China. At a first glance, it seems that in China there is not yet a sufficiently intimate relation between the university men of science and the growing industries. There is also perhaps a tendency to over-emphasize applied science in the short-term sense at the expense of pure science, especially in the training of students and the sending of them abroad. The scientific man is ordinarily ignored or treated as academic and unpractical; but on occasions is expected to produce practical results without delay by those who have turned a deaf ear to his requests for adequate material support and essential research supplies. The advantage of his advice within the Government organizations themselves is also not fully appreciated.

In these two articles it has been impossible to do more than run over some of the salient features of Chinese science in the far south-west. The main impression which remains with the visitor to the scientific institutions of this vitally important province is of the quite indomitable perseverance and courage which the Chinese scientific workers have shown in carrying on in the remote parts of their country, and of the extraordinary cheerfulness and even gaiety which they show in the midst of their adversity.

STRUCTURE OF α-KERATIN

By DR. IAN MACARTHUR*

Textile Physics Laboratory, University of Leeds

THE structure of the keratins is of interest alike to wool technologists and protein structure analysts. Interpretation, by Astbury and his colleagues[1-4], of the essential features of these fibres in terms of the shape and interlinking of polypeptide chains has earned increasing recognition. The results, achieved from relatively simple X-ray data determined under controlled conditions and used in conjunction with other physico-chemical findings, together with general advances in our knowledge of macromolecular systems, demanded an extension to more intensive X-ray methods. Accordingly, with the support of the International Wool Secretariat, an investigation in progress for some time in the Textile Physics Laboratory, University of Leeds, has aimed at improved range and definition in keratin fibre X-radiograms, with the final objective of a complete analysis of the more crystalline material. Some longer spacings[5-7] were already available, and some preliminary findings have been reported[8]. Analysis is still in its earlier stages, but in view of the interest attaching to very recent work[9,10] with which the present investigation is bound up, a factual publication is not premature.

Technically, use has been made of chromium, iron and copper $K\alpha$ radiation, low-dispersion beams defined by precision ribbon and bore collimators, vacuum cameras, longer-distance photographs, and to some extent monochromatic radiation. The necessarily long exposures have been reduced to reasonable limits by the use of a high-power rotating-anode X-ray generator[11]. Keratin types examined include horn, horsehair, mohair, wool, and especially porcupine quill.

The sharpest and most complete fibre pattern is given by the cortex of African porcupine quill tip (Fig. 1); definition and orientation are poorest for horn. The fibre photograph varies somewhat with the keratin type, at least in completeness, degre of orientation, resolution, and probably also i relative intensities; but the main structure an reflexions are similar. Different specimens of a give type show variations in crystallinity and (slightly) i lattice spacings; while for a given specimen ther are variations also with treatment and condition (humidity, tension, pressure, etc.). The quill photograph will be considered typical for the keratin series

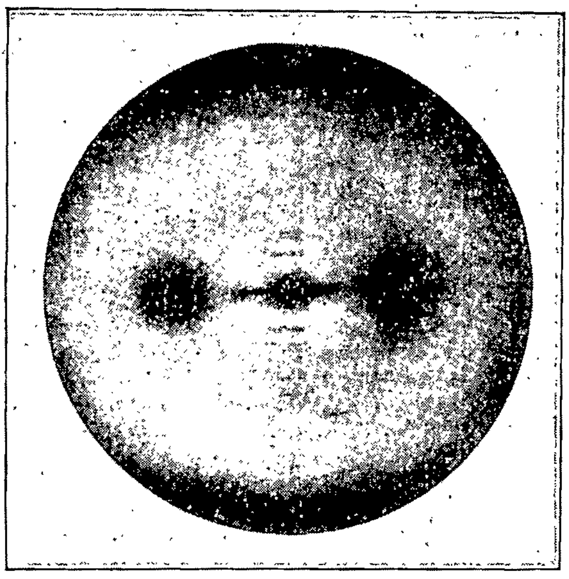

Fig. 1. FIBRE X-RADIOGRAM OF AFRICAN PORCUPINE QUILL TIP. PLANE PLATE; R, 9·8 CM.; COPPER $K\alpha$ RAYS; DRIED, P_2O_5 + VACUUM; COLLIMATOR, 13 CM. × 0·025 CM.

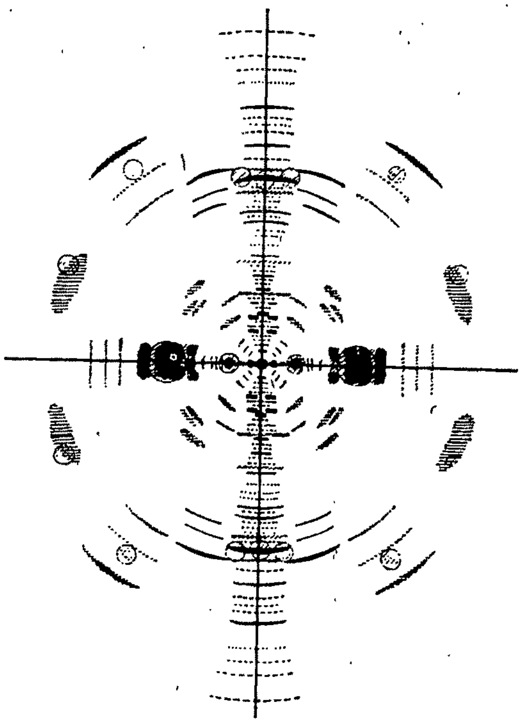

Fig. 2. COMPOSITE CHART OF α-KERATIN DIFFRACTION PATTERN GIVEN BY PORCUPINE QUILL. FIBRE AXIS VERTICAL; PLANE PLATE. (TO D 3A.)

For quill, more than a hundred reflexions hav now been secured in the range 1–150 A.; as show by their interrelation and proportionate response t physical conditions, these refer to the same structure The rich spectrum invites comparison with that o feather keratin[12]. Fig. 2 is a composite diagra showing the α-keratin diffraction pattern for dr porcupine quill tip, down to 3 A. spacings; th circles are the original reflexion areas noted fo animal hairs by Astbury and Street[1].

The reflexions differ in quality. The extensiv meridian and near-meridian series with the dominan line at 5·14 A. are sharp spots or arcs; they characterize regularity along the fibre axis. The equatorial refer to lateral arrangement and include both shar and diffuse reflexions, the latter at least in part du to lack of resolution. Their main groups are strong and sharp long spacings (for example, 81, 41 A. a room humidity) and the strong area at ∼ 9·8 A. This latter is now considerably resolved, showing a fine structure parallel both to meridian and equator, and containing possibly twenty discrete reflexions. The strongest components occur at 9·2 and 10·5 A., the mean, 9·85 A., giving Astbury's side-chain spacing. In the dry specimen non-axial reflexions are poorly defined; but the importance and location of structural water content in keratin are shown in the way the non-axials resolve and sharpen, even ith moderately disperse beams, at definite humidi-es ; meridians are practically unchanged.

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Stretching beyond a fibre extension of 10 per cent difficult to realize with the highly crystalline quill p ; but in this range the α-structure, in addition to ogressive destruction, undergoes an easily followed versible 2 per cent expansion fibre-axially and an pparent slight reduction in cross-section. Greater fibre tensions yield the β-pattern without superstructural ng spacings. Release of the β-form in water re-enerates the α-pattern, now much weaker in meridian e detail, but sharper and fuller in equatorial solutions ; a similar but less marked change occurs so in traversing the 2 per cent cell-extension range α-keratin. The feature illustrates the difference etween the tighter unions of protein chains giving permanent framework, and the extreme mobility f chains in the rubberoid plastics, in the latter of which retching enormously improves or indeed creates ifficient order to record as a fibre X-radiogram.

Striking inter- and intra-crystalline phenomena ccur with increasing humidity. Meridian spacings re very slightly (less than 0·7 per cent), equatorials onsiderably (3–10 per cent), increased. This recalls omparable temperature phenomena with *n*-aliphatic ng-chain compounds[13,14] and in itself resolves the irection of the axial covalent polypeptide chains om the looser cross-sectional links of ionic, S-S, -bond, or van der Waals type. Differential lateral xpansion with stretching, swelling, or temperature hould facilitate crystallographic indexing. Though e variation with swelling is ample and apparently nisotropic, certain assignments have not yet been ade because of the broad and composite nature of ese reflexions, and the possibilities of other than imple crystallographic cell interpretations.

X-ray interpretation of fibrous protein structure an follow two lines : the broadly physico-chemical r the more rigorously crystallographic. With such ata as those of Fig. 2, the second method becomes creasingly feasible, but special caution attends its se. Not only does lack of resolution occur in fibre -radiograms of macro-units formed of protean chain ystems, but also X-radiation and prolonged stretch-ng permanently affect the keratin substance. There the possibility of two or more phases, not necessarily f identical chemical composition, and that, indeed, o be inferred largely from data for assorted wools. s the 'crystalline' phase a molecular lattice, or is it ue to such parts of a chain system as can form local rder through suitable chemical and spatial charac-eristics ? Are reflexions all normal ones of a unit ell, or may a small number of large units per micelle imension demand sub-indexing, as seems possible or viruses[15] ? Is the diffuseness of certain groups of eflexions due to (*a*) thin or imperfect crystallites, *b*) mere lack of resolution of overlapping spots, c) the diffuse scattering of elastic, thermal, or Raman ibration systems, (*d*) a secondary structure of grids r layers with only average regularity and differing ossibly in reflecting power ? Are we dealing with a nember of a structural series in which intramolecular esidue or chain or grid interchange parallels the tomic or molecular replacements of alloys and solid olutions generally ? Such possibilities, some readily ismissible, will be discussed elsewhere ; it will be rovisionally assumed that the recorded reflexions rise by Bragg scattering.

The sharp meridian (0*k*0) series are orders of a rge unit of pattern along the fibre axis. This unit either 658* or 198 A., the ratio being 10/3. Discrimination is not easy. The latter is a good fit for many full sequences, but lacks a second order, and, in particular, the sharp 5·14 A. spacing seems just too far out to fit. The fine structure of the strong 9·8 A. equatorial is too vague to distinguish between a second order of 198 and a sixth of 658. Fitting to 658 A. is good but less critical. But the number itself is significant. Accepting an approximate 100 per cent chain extension in passing from α- to β-keratin[2], it follows that three amino-acid residues occupy the length of 5·14 A. Thus 658 A. corresponds exactly to 384 (= $2^7 \times 3$) residues. To accord with present chemical analyses (for wool), a molecule would contain $2^6 \times 3^3$ residues, or a multiple thereof. The simple metrical relation of these Bergmann numbers is strongly suggestive. These are easily reconciled crystallographically even if a single chain is chemically representative. In fact, certain simple folds are found to give cell cross-sections that accord with much of the X-ray data, yield a cell containing 2^m3^n numbers of Svedberg units ($M \sim 17{,}500$), and are feasible on general grounds. Not only is this fibre periodicity significant, but the intensity distribution is also peculiar : the dominant meridian spacings and stronger layer line translations expressed as orders of 658 A. are also generally very closely of the form 2^m3^n (cf. Table 1). The order (2^7) of the very strong meridian contains the L.C.M. of the 2^m factors in the proportions of component residues (wool).

The 2^m3^n rule for dominant meridian orders holds best for the longer spacings. For spacings less than 4 A., thus approaching atomic bond distances, the fine structure of the polypeptide chain begins to be appreciable and introduces its own periodicities. Curiously, even the 2^m3^n rule scarcely discriminates for certain between the values 658 and 198 A. For

TABLE 1. DISTRIBUTION OF MAIN REFLEXIONS ALONG THE FIBRE AXIS IN X-RADIOGRAM OF α-KERATIN (AFRICAN PORCUPINE QUILL TIP).

Intensity (*I*)	Spacing (*D*)	Order of 658 A.	Nearest 2^m3^n
1. *All* meridians or very-near-meridians of $D \geqslant 5 \cdot 1$ A. with $I \geqslant w+$			
m	66·3 A.	10	9
m	*27·8	24	24
m	*19·95	33	32
wm	18·10	36	36
w+	13·11	50	48
m—	12·35	53	54
w+	10·44	63	64
m—	6·16	107	108
v.str.	5·14	128	128
2. Other dominant meridian reflexions			
m	4·45	(app.) 148	144
w—	4·00	,, 164	162
w—	3·42	,, 193	192
w+	3·08	,, 214	216
vw	2·55	,, 258	256
(?)	2·29	,, 287	288
m+	1·49	,, 442	432
3. Prominent non-axial spots or groups			
	* (appr.)	(appr.)	
vw	63	10½	—
vw	43	15	16
vw	23·8	27½	27
vw	17·5	38	36
m	14·5	45½	48
m+	13·3	49	48
vw	12·2	54	54
w	8·83	74½	72
w+	6·18	106½	108
wm	6·10	108	108
w+	5·71	116	—
m+	5·65	117	—
m-str.	5·12	128	128
w+	3·35	196	192
w	3·17	208	216

* Layer line translation.

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* The value 642 A. originally quoted[8] was referred to an *unstretched* spacing of 5·06 A. for the dominant meridian[3]; the new value, 5·14 A., should be more accurate.

certain higher orders (2^m3^{3+p}) of 658, this is necessarily so as $198/658 = 2^3/3^3$ to 1 per cent. As shown below, lower orders transfer to orders of 198 A. (to not more than 0·2 off integral) which do not differ from the 2^m3^n rule beyond 1 unit:

Order of 658 A. ..	10	24	33	36	53	63	107	(117)	128
Order of 198 A. ..	3	7	10	11	16	19	32	35	(38·4)

Explanations of periodicities and intensity distributions involving mainly 2's and 3's can be derived from (*a*) crystallographic symmetry operations on a unit of structure, (*b*) a material framework, possibly largely independent of local chemical composition, but involving 2's and 3's (for example, molecular ring or hexagon units), (*c*) *ad hoc* distributions of specific components.

The repeat unit along the fibre axis (if 658 A.) and the intensity distribution of its orders, taken in conjunction with the molecular proportions of the component amino-acids in (wool) keratin, suggests that *spatial distribution and not only relative amount* of the amino-acids is regular; the simplest model to explain it is a multiple-ladder structure, the analysis an extension of that of Shearer[16] for the simplest of long-chain polar molecules (*n*-aliphatic ketones). Consider the properties of an open-chain composite-ladder molecular keratin model, the main rib (polypeptide chain) having side-rungs (component amino-acid residues) distributed along its length, each regularly in its own period. Let the ladder-structure be a 2^M3^N number of residues long (X-rays and elastic properties) and the residues occur in $2^{-m}3^{-n}$ molecular proportions (chemical analysis). The number of a given residue per molecular length is $2^{M-m}3^{N-n}$. Neglecting fine structure of the chain itself, the structure factor of a cell containing one such model molecule is such that only for orders with k indices characteristically related to the particular $2^{M-m}3^{N-n}$ occurring are meridians of any intensity; further, not all these values need occur strongly. The orders appearing and their intensit depend on the scattering weights, periodicit relative phases and average dispersion in the fib axis direction, of the side-rung residues, and also any regularly occurring chain configurational feat that does not conflict with the validity of the 2 relationship. For wool keratin the first four fact can be quite accurately estimated and a fitting soug for any postulated configurational chain feature.

Straightaway, the model needs progressive mo fication to accord with porcupine quill kerat (Unfortunately, adequate chemical analyses are not y available for porcupine quill itself, but the co parative data of Table 2 indicate that probably serious error would be introduced by using t figures available for wool keratin.) First, a sing chain molecule shows 'clashes' in its subperiodicitie the model must then extend from chain to grid scaffold. Again $M-m$, $N-n$ must be positive or zer While the $2^7 \times 3$ and $2^6 \times 3^2$ data are subject t revision, $N-n = -1$: an adjustment with the effec of a triple long-range fold is required. Both correc tions tend in the direction of a cell of probably larg cross-section, as found. Further, symmetry opera tions, for example in a polymolecular cell, an certain regular short-range chain corrugations coul affect the dominant periodicities, and the latte would also introduce additional weighting.

But most important of all to explain are th common broad structure and properties of th keratin-myosin series. The most probable interpre tation would seem to be that chain periodicities which in themselves do not account for the mai similarities of the keratin-myosin series, must b superposed on some skeleton structure based on close-range chain folding for which the general evidence[1,2] is tremendously strong. Such folding would introduc additional weighting, though not necessarily differen periodicities outside the 2^m3^n scheme. In fact, the new α-model does this. Astbury's original chemical

Table 2.

Muscle			Canad. porcupine quill			Wool[2] (Lincoln)			Mohair			
D	*I*[3]	Approx. order of 128 *D**[1]	*D*	*I*	Approx. order of 128 *D**	*D*	*I*	Approx. order of 128 *D**	*D*	*I*	Approx. order of 128 *D**	Neares $2^m \times$
A.			A.			A.			A.			
26·3	str.	25	27·5	m-str.	24				27·5	(m)	24	24
						24·6	m	27				27
			20·3	m	33	20·0	m	33	20·4	m	33	32
19·1	m	34½										36
						15·9	wm	42				—
13·82	wm	48	13·8	wm	48				13·7	m	49	48
			12·6	m+	53	12·7	wm	53				54
11·09	m-str.	59										—
			10·7	m	62	10·48	wm	63	10·65	w	63	64
9·22	m-str.	71				9·41	wm	71				72
7·95	wm	83	7·94	w+	83							81
			7·33	wm	91							—
6·89	wm	96	6·66	m—	100				6·67	w+	100	96
			6·27	m	106	6·28	m	106	6·24	w+	107	108
5·13*	str.	128	5·18*	str.	128	5·20*	str.	128	5·20 *	str.	128	128
4·60	w+	143	4·47	w+	148							144
4·34	w+	151							4·42	w	150	—
4·10	w+	160 (110)*F*[4]				4·15	w	160 (110)*F*				162
									3·39	w	196	192
3·62	w	(200)*F*				Unsoxhletted wool						—
2·89	w	(210)*F* or *C*[5]										—
2·46	vw	(020)*F*				2·55	w	(020)*F*				—

Horsehair			Horn			
63·5	w	10				9
27·5	w—	24				24
12·5	vw	53				54
6·10	vw	108				108
5·17*	m	128	5·15*	wm	128	128

Table References

[1] 128 *D** taken as major period.

[2] Very similar for Wensleydale.

[3] Intensities: *w*, weak; *v*, very; *m*, medium; *str.*, strong.

[4, 5] *F*, fat; *C*, collagen.

ucture[2] devised to explain the 5·1 A. meridian
d the quantitative relations of the α ⇄ β trans-
mation has been shown by Neurath[18] to leave too
tle room for certain side-chains. The new α-model
s a simple structural basis, the *close-packing of*
le-chains, which results in a square-stepped poly-
ptide chain of unit 5·1 A., thus yielding the strong
eridian reflexion little dependent on side-chain
eighting; that is, on *chemical composition as such*,
t, of course, accounting only for the main X-ray
atures. This structure is stereochemically accurate
d accords with many broad factors: a common
inciple for fibrous proteins, the right density for
lymorphic transitions, a simple intramolecular
ereoisomerism for the α ⇄ β transformation, correct
stances for hydrogen bond backbone linkage
etween adjacent chains, and, of course, a close-
cking of side-chains. In short, along the fibre axis
e probably get a regularly *spaced* grating (period
l A.) with its planes very regularly varying in
flecting intensity over a much larger (658 A.)
eriod. A combination of this main structure and
eriodic fine structure to fit the experimental data
at present under investigation.

Provided the very regular porcupine quill fibre
ructure is not too disoriented by chemical treat-
ent, the work of Speakman[17] on the chemistry
f the cross-links in wool invites the possibility of so
emically weighting selected residues as to promise
eir location by comparative analysis of the varying
tensity distribution in the (0k0) meridian series.
xperiments with heavy metal and other atoms are
progress.

The fine periodicity is necessarily in size and
eflecting power a function of chemical composition.
he inter-linking of the keratin-myosin series thus
epends on the standard skeleton, with the side-
hain positions as sites, or by interchange of chains
r grids—an intramolecular parallel to solid solutions.
eeping in mind the chemical relationships[19], in
-radiograms of the series we would then expect:
) a standard effect on the intensities imposed by
he common configurational feature; (*b*) very
imilar fibre-axis periodicities (~ 658 A. as in quill);
) the dominant (fairly large spacing) reflexions
robably 2^m3^n orders of this; (*d*) the particular
${}^m3^n$ orders similar for the keratin members, with
light intensity variation, but more markedly different
or myosin.

This is largely borne out, as seen in Table 2, which
ives some meridian reflexions obtained for various
-keratin types together with measurements of an
arlier (Astbury) fibre X-radiogram of dried sartorius
uscle (frog) at 50 per cent extension. Especially
or the latter, precision is not sufficient to *determine*
acroperiods, and the strong 5·1 A. lines are taken
s the 128th order. Of the few reflexions that appear
ot to conform, three or four lines of a sharper nature
n muscle (of which myosin is the principal con-
stituent) are just those which clearly can be
ndexed as the chain cross-sectional reflexions of the
atty constituent or the prominent meridian arc
ssociated with collagen.

Analysis proceeding will be reported elsewhere.
What is important is that the keratin-myosin group
f protein fibres is amenable even in detail to search-
ng X-ray methods; that the new information
lready obtained for α-keratin shows suggestively
imple regularities in accord with those from quite
ther sources; and that the results substantiate and
an now check in detail the new α-model which reconciles the broadest of protein characteristics and, while specific enough for quantitative treatment, is simple and accommodating in detail, as, of course, the biogenesis of proteins demands.

This work is being carried out under the direction of Dr. W. T. Astbury in the Textile Physics Research Laboratories, and under the joint auspices of the International Wool Secretariat and Department of Textile Industries, University of Leeds, to all of whom the writer offers his most cordial thanks.

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THE ISLAND OF NEW GUINEA*

By L. Evelyn Cheesman

THIS huge tropical island is only partially explored. Even the coasts are not yet thoroughly and accurately charted, and though there are few large areas of the vast hinterland entirely unknown, only the main topographical features have been named and located in an approximate position. Early records, too, need to be checked; this was proved by one of the Papuan patrols, which found a large lake where the Arthur Gordon Range was supposed to be. The traveller is, therefore, always inadequately equipped for penetrating what is for the most part an exceptionally difficult type of country, whether it be mountains or swamps.

The early geological history of New Guinea can only be indefinitely conjectured since there has never been a general survey. Briefly, it can be summarized thus: Palæogeologists postulate a large land mass, which they named Palæonotis, as having extended from Asia to Australia during the Middle Cretaceous period, and extending as far as New Caledonia, and westward to Sumatra and Java. Some time during the Early Eocene, part of this land broke away from the Australian shelf and later submerged. From this submerged land mass the great folding movements of the Miocene-Pliocene periods raised the high central mountain system of New Guinea. During the next epoch connexion with the Philippines sank, and the island took form as we know it to-day. A more recent connexion with Australia is supposed to have taken place in the Late Pliocene, when the Torres Strait was dry for a relatively short period, allowing the marsupials and other Australian groups of plants and animals to migrate to New Guinea.

It would be thought that geologically young land

* Substance of a Friday discourse at the Royal Institution delivered on May 28.

raised from the sea, its sole continental connexion being with Australia, would possess a fauna and flora basically Australian; also that these would be incomplete with many gaps in the groups. On the contrary, New Guinea has continental fauna and flora, of Asiatic origin, with no serious gaps in the totality of groups such as to suggest population by temporary land bridges. The suggestion is rather that there was connexion with an older fully populated land. There is a strong Australian element, a Malaysian element, and a weak South American element which could have been introduced via Australia.

A possible explanation is to be found north of New Guinea, where are remnants of very ancient mountain ranges, some of pre-Cambrian rock, on an alignment parallel with that of the main ranges. These are: the west coast of New Britain, the Finisterre and Torricelli Ranges, Mt. Oinake, the Cyclops Range, Japen and Waigeu Islands. Supposing these to be part of an old land mass, populated from Asia, which remained above water long enough to colonize the young land of New Guinea as it rose from the sea, this would account satisfactorily for the origin of the Papuasian flora and fauna, which are characterized by a very rich neo-endemism, indicating isolation over a long period.

The Papuasian faunal sub-region includes adjacent archipelagos, the Solomons and New Hebrides archipelagos and New Caledonia.

It is interesting to note in connexion with the above that the Cyclops Range, of very ancient pre-Cambrian rock and old crystalline schists, shows no indication of submergence; no maritime deposits have ever been recorded from the mountains. Another interesting fact emerges from records by geologists of an Australian oil company working in this region for fifteen years, who found evidence of tectonic movements still proceeding in the Torricelli Range.

Reef limestone belonging to many periods and exhibiting an endless variety in formation occurs throughout New Guinea from the coast to high mountains. The formidable "limestone barrier", crossed by Karius and Champion in 1928 between the sources of the Fly and the Palmer Rivers, is described by them as consisting of series of pits of varying sizes, some as much as 100 ft. in circumference, with pinnacles and knife-edged ridges between them. What is probably a similar type of formation appears on Waigeu and also on Japen. On the former island, series of small narrow ranges of about a thousand feet in height have built up the eastern shore of Mayalibit Bay. Between these ranges are very deep clefts almost to sea-level, the ridges are castellated, of rough sharp-edged rocks, with deep pits between the peaks—most dangerous to negotiate especially when screened by vegetation.

Sea erosion produces curious three-sided cylindrical clefts in limestone cliffs, as on the north side of Oinake Massif on the boundary between Dutch and British Territories. One example on Djoea Bluff between 200 ft. and 300 ft. high pierces a cliff to the beach.

Volcanic intrusion occurred in the north of New Guinea; a few volcanoes are still active on the coast. In 1933 a violent earthquake wrecked the Torricelli Range. This ranks with the world's most severe earthquakes. So late as 1939 the northern slopes were still bare precipices, quite an arresting sight in that luxuriant forest; valleys were still choked with rocks, rivers were forming new channels, and huge tree trunks, still standing, have been split a twisted in a peculiar fashion as if wrenched by giant fist.

There is not so much variation in temperature might be expected; the thermometer registers 74 84° F. up to an altitude of 3,000 ft. Above this t temperature falls a few degrees; 38° at night h been recorded at 10,000 ft. On the highest mou tains, 16,000 ft., snow and frost occur. Carste Top, 15,709 ft., has large glaciers.

Rainfall is extremely heavy over nearly all t island, but varies very greatly in localities. The are two seasons marked by the north-west and sout east monsoons. Dry areas or savannahs wi characteristic vegetation occur contiguous with hig rain forest. They are accounted for by the alignme of mountain ranges. Where strong rain-laden win blow parallel with ranges, areas on each side a drier, and where high mountains obstruct the passa of these winds, there is a very heavy rainfall. Thu Port Moresby at the end of one savannah has a annual rainfall of 32 in., while the governme station of Kikori at the farther end among hig peaks has 232 in.

The savannahs are distinct from areas deforeste by natives to make their villages, on which a secon ary vegetation replaces the forest, principally plants and trees of rapid growth, and species with very wide distribution. There are many such area especially on mountains where a large native popula tion has flourished, which has either died out o moved to another locality. Even the alpine grasslan of high mountain tops where are no native village is disturbed by human agency, being often partiall destroyed by the fires of native hunters.

New Guinea is fortunately outside the cyclon zone, but is subject to very high winds, gales, squal and cyclonic disturbances. In Papua occur sudde very violent squalls known as *gubas*. In Netherland New Guinea in the first week of October, gales fro the north-west called *wambrau* blow with terrifi force for eight or ten days, after which they subsid as suddenly as they began. It is an uneasy experienc to be among the mountains during this period Hundreds of trees are blown down; there is n adequate shelter from torrential rain except roc caves, for the rain is driven horizontally. Nothin can be seen but steamy white clouds being carrie by with an amazing velocity, or the grey, drivin sheets of rain. Coastal tribes recognize by certai signs, such as brilliant sunsets, the approach of th *wambrau*; canoes race to shelter and are drawn u on beaches. The south-east of New Guinea does no experience these gales, but apparently (according t verbal reports) they are felt at the same date nort of the Papuan Gulf, and they probably blow acros a wide zone of the centre of the island except wher high mountain masses intervene.

The native population is Papuan-Melanesian characterized by stiff, kinked hair, which gave the the early name of Papoo, that is, "fuzzywigs" Several influences can be detected which result in considerable variation in build, skin colour, an facial features, as well as character of the hair, whic is fine and straight or waved in true Melanesians an Malaysians. In some tribes the skin is definitel lighter in colour, with a bronze tint.

True pigmies exist, mainly in high mountai regions, where they are thought to have taken refug from stronger, aggressive tribes. In certain district are small Negritto-Papuans, resulting from som crossing of types not clearly understood, and presenting variations in size of adults even in one family.

Within the last ten years, gold prospectors made discoveries of densely populated areas in the highlands of the Mandated Territory which had always been supposed to be sparsely inhabited. These tribes had evolved an extremely interesting and advanced type of agriculture.

Head-hunting and cannibalism certainly are still practised, but such customs are becoming rarer. As Papuans come in contact with more advanced peoples, public opinion among themselves is apt to change, and such barbarous practices are deprecated and will finally be voluntarily abandoned.

All Papuan tribes fall into two categories, they are either people of the forest or people of the sea. From babyhood they are taught to observe every landmark, changes in the sky with nuances of which we are scarcely conscious; all have distinctive names, as also all living things however small. Frequently there are different names for the two sexes, even of insects. Sea people are as unhappy when away from the coast and as terrified of mountains as forest people are unhappy in coastal areas and terrified of the sea.

With its rich tropical vegetation, New Guinea is surprisingly poor in natural products to support human life. The indigenous population flourishes only where animal or fish diets are plentiful. Some tribes appear under-nourished. Among vegetables cultivated in native gardens the introduced sweet potato is of good food value; the same cannot be said of other roots, taro and yam. Sweet potato alone can sustain white men in good health; this was proved by Champion and Anderson in the Bamu-Purari Patrol, 1936. Sago, which is the main food of many tribes, is not a white man's diet; it is indigestible and has no energizing value; this was proved by the Karius-Champion Patrol of 1928.

Papuans are extremely primitive, with a Stone Age mentality. Individuals exhibit a marked intelligence, but few outside influences appear to make lasting impressions. When working with white men, opportunities for mastering machinery or for learning storekeeping, mining, etc., may arouse latent ambitions, and the Papuan proves reliable and independent, although in most cases his acquirements are parrot-wise without undue reference to his reasoning powers. For the Papuan exists almost entirely subconsciously; his entire being is not only associated but also closely interlocked with all objects—human, superhuman, animate and inanimate—which compose his natural surroundings. His instinctive reactions to his outside world are scarcely comprehensible to those guided by reason; his power of self-suggestion is unbridled, so that death may be caused by a paroxysm of fear of something entirely imaginary. Control of his own vitality exists to an astounding degree. This mental attitude of Papuans must be realized by those who have any dealings with them, for thus many tragedies may be avoided. Belief in the supernatural is fundamental; it cannot be eradicated; and no other beliefs are sufficiently interesting and stimulating to be substitutes.

Scientific collections from New Guinea have been augmented of late years, due to the efforts of scientific societies and of individuals. Most valuable collections have reached the United States from the Richard Archbold Expeditions, particularly from the latest, 1937–38, when systematic collecting was carried out at different altitudes on the highest mountains of Netherlands New Guinea. A flying-boat is used as transport on these expeditions. Air transport is undoubtedly the solution to all difficulties of collecting on that island, and where the financial aspect need not be considered, should definitely be adopted.

NEWS and VIEWS

Royal Society of Arts : New President

DR. EDWARD FRANKLAND ARMSTRONG has been elected president of the Royal Society of Arts, of which he has acted for a number of years as treasurer. Dr. Armstrong is highly qualified to occupy this distinguished position, for he is a man who has not only made valuable contributions to scientific research in many fields of pure chemistry, both organic and physical, but has also held many high positions in the world of industrial chemistry, where his influence and guidance have led to important advances. As one of the small band of men who worked with the great van't Hoff during his sojourn in Berlin, Dr. Armstrong was successful in clearing up the phase transformations and equilibria of calcium sulphate and its hydrates, a problem which had greatly puzzled van't Hoff and some of his earlier collaborators.

During the period (1915–19) when Dr. Armstrong was managing director of Joseph Crosfield and Sons at Warrington, he carried out in collaboration with his chief chemist Hilditch (now Campbell Brown professor of industrial chemistry at the University of Liverpool) an important and pioneering series of researches on the catalytic hydrogenation of oils and fats. He has also done valuable original work in the field of carbohydrate chemistry, and is the author of well-known monographs on the simple carbohydrates and the glycosides. Apart from the numerous high industrial and administrative positions which he has held, his wide experience as president of the Society of Chemical Industry (1922–24), chairman of the British Association of Chemists (1926), chairman of the Association of British Chemical Manufacturers (1930–33), and chairman of the British Standards Institution (1934–35) will be of great value to the Royal Society of Arts.

Royal Society of Edinburgh: Honorary Fellows

THE following have been elected honorary fellows of the Royal Society of Edinburgh:

Foreign Fellows: Prof. G. D. Birkhoff, professor of mathematics, Harvard University; Dr. H. S. Gasser, director of the Rockefeller Institute, New York; Dr. D. Emilio Jimeno Gil, rector of the University of Barcelona; Prof. Thore G. Halle, Naturhistoriska Riksmuseum, Stockholm; Prof. H. S. Jennings, Walters professor of zoology and director of the

Zoological Laboratory, Johns Hopkins University; Prof. P. Karrer, professor of chemistry and director of the Chemical Institute, Zurich; Prof. O. Veblen, professor of mathematics at the Institute for Advanced Study, Princeton.

British Fellows: The Right Hon. J. C. Smuts, Prime Minister and Minister of External Affairs and Defence, South Africa; Prof. H. F. Baker, emeritus professor of geometry and astronomy in the University of Cambridge; Sir Joseph Barcroft, emeritus professor of physiology in the University of Cambridge; Sir Lawrence Bragg, Cavendish professor of experimental physics in the University of Cambridge.

University of Birmingham

At the annual degree congregation of the University of Birmingham, the Chancellor (Viscount Cecil) conferred the honorary degree of doctor of laws on Dr. Benes, President of the Czechoslovak Republic, Mr. J. G. Winant, American Ambassador to Great Britain, Mr. R. G. Casey, Minister of State in the Middle East, Sir Edward Appleton, secretary of the Department of Scientific and Industrial Research, and Dr. H. R. Ricardo, a pioneer in the development of the high-speed internal combustion engine. In introducing Mr. Winant the Public Orator said: "What is clearest in these dubious times is that in international conflict his country and ours stand for the same things and stand or fall together. We shall not fall. This University has not fallen but is still working on, diminished but not brought low, making light of scars upon her buildings. Her desire is to see Americans and British continuing to work together, mix together, in time of peace as they are so freely doing in time of war, and from this hour to be mixed up herself, as inextricably as possible, with Mr. Winant, with the American universities and with the entire people of the United States".

Mr. Winant, in a short address, said: "We need opportunity for an education which includes understanding of one another if we are to be far-sighted and if we are to see friendly but distant lands. We have a shortage of teachers throughout the world to-day, and yet I believe we have new techniques which would help in that situation if we put our minds to it. The international picture language of Isotype and documentary films, the tactile aids to instruction, which have been evolved in the work of nursery schools, are examples. All of them have this in common: they operate through the medium of a common language, the language of eye and touch. Such new instruments of education—which may well mark an advance of human enlightenment without parallel since the invention of printing—are international in scope. Mass production can provide a system of education by the universal picture language of Isotype, or by the international picture language of the documentary film, at once attractive and, as such, capable of creating its own demand, suitable for use by people who speak different tongues, and equally adaptable to the re-education of those who have been indoctrinated with the Nazi virus and to our own needs, if we envisage the problem of re-educating Fascist youth as part of the wider problem of our common re-education to the tasks of the century of the common man. You can do a great service in Birmingham University to all mankind if you make these new tools available so that we can this time finish the job."

Ministry of Food: Cereals Research Station

The Ministry of Food has, by arrangement with the Department of Scientific and Industrial Research and the flour milling industry, taken over for the period of the War the extensive laboratories at St. Albans which were previously occupied by the Research Association of British Flour Millers. The Ministry will have the advantage of the use of these laboratories and the existing staff for the consideration of all food research problems, but they will continue to be used in the main for specialized work connected with cereals and cereal products. The laboratories will, in future, be known as the Cereals Research Station of the Ministry of Food. Dr. P. Moran, who was previously director of research to the Research Association of British Flour Millers, has been acting as deputy scientific adviser to the Ministry since June 1940. In March last he was appointed, in addition, director of research in the Ministry of Food. In this latter capacity he will direct the work at St. Albans. From June 1, the date on which the transfer took place, the entire control and direction of the laboratories passed to the Ministry of Food.

The Solar Corona and Geomagnetism

The recurrence of certain terrestrial magnetic storms at intervals of 27 days (the sun's rotation period) without any disturbance being visible on the sun's disk has long been an outstanding puzzle of solar physics. Observations of the chromosphere in monochromatic light have established a close connexion between the chromospheric eruptions responsible for short-wave radio fade-outs and certain of the great sporadic magnetic storms, which tend to occur about a day after the visible flare; but the recurrent storms seem as unconnected with chromospheric activity as with photospheric. A recent observation by Waldmeier (*Z. Astrophys.*, **21**, 275; 1942) throws light on this subject. By coronagraph observations at Arosa he has found that certain regions of the solar corona ("*C*-regions") exhibit temporary bursts of activity characterized by abnormally high intensity of the coronal line at 5303 A. The appearance of these areas at the sun's edge is often followed, or preceded, according as the region is being carried in front of or behind the disk by the solar rotation, by magnetic activity on the earth, the time interval being about 7 days (roughly a quarter period). The *C*-regions are very long-lived compared with chromospheric eruptions (at least 24 days as against about an hour). They are confined to the spot zones and seem to exhibit the 11-year periodicity in their frequency of occurrence. If further observations should confirm the connexion between magnetic storms and the central meridian passage of these active zones in the corona, it would seem that both *C*-regions and chromospheric eruptions must emit corpuscles, roughly radially and at speeds up to about 1,000 miles per second, throughout their life-times of the order of a month and an hour respectively.

Statistics of Public Opinion

Public opinion research may be considered to have started with Dr. Gallup, who predicted the voting in the presidential election in the United States of 1936 with an error of only 6½ per cent. For later elections the error has been reduced to 2½ per cent. His method is to choose a sample of about 30,000, which is divided up for age, income, sex, and geographical location in the same proportions as the total population of the United States. Similar predictions are made for local elections in Great Britain by the British Institute of Public Opinion, using a sample of 1,500–2,000. The procedure seems very satisfactory for forecasting election results, but for estimating public opinion on such questions as confidence in the Government, statistical methods may be very misleading. In a paper entitled "The Limitations of Statistics in the Field of Public Opinion Research", read before the Manchester Statistical Society on April 14, Mr. J. G. Ferraby argues that for many purposes the qualitative methods adopted by Mass Observation are preferable. These rely largely on a panel of voluntary observers, who answer written questions drawn up by headquarters, keep diaries, forward letters received by them which comment on general topics, and report conversations, including some not intended to be overheard. It is claimed that this method subordinates accuracy of detail to accuracy in presenting a true picture of the whole. It is not explained how the accuracy of the observers or the truth of the picture is checked.

Earthquakes Registered at Kew and Stonyhurst

SEVEN strong earthquakes were registered at Kew Observatory during the month of May 1943. The first was on May 2, recorded at 01h. 10m. 17s. U.T., and has been reported as having been felt in Württemberg in Germany. The second, also on May 2, began recording at 17h. 30m. 11s. U.T. from an epicentre some 8,700 km. distant, and attained a maximum ground amplitude of 180 μ at Kew at 17h. 58m. 23s. U.T. The third, on May 3, began recording at 02h. 13m. 01s. U.T. from an epicentre some 11,000 km. distant, and attained a maximum ground amplitude at Kew of 200 μ at 03h. 03m. 15s. U.T. The fourth, not so large, was recorded at 09h. 15m. 54s. U.T. on May 20. and the fifth, on May 22, recorded at 22h. 10m. 37s. U.T., has been reported as having been felt in Italy. The sixth was by far the largest of the month. It was recorded at Kew at 23h. 21m. 54s. U.T. on May 25, and from the provisional interpretation of the record came from an epicentre some 12,500 km. distant. It attained maximum ground amplitude at Kew of 340 μ. At Stonyhurst the shock was also recorded at 23h. 21m. 54s. U.T. on May 25, and from a tentative interpretation of the record, came from an epicentre some 105° distant. The seventh earthquake was recorded at Kew at 00h. 27m. 01s. U.T. on May 28, and attained a maximum ground amplitude at Kew of 35 μ. It appeared to come from an epicentre somewhere near the one first recorded in the month. This shock was also recorded at Stonyhurst at approximately 00h. 28m. 20s. U.T. The German radio reported an earthquake at about this time, the epicentral region being west of Balingen near Stuttgart. Some roofs and chimneys are stated to have collapsed, causing injuries to people, and "strange glows" are reported to have been observed. The shock was also reported felt in Württemberg and Baden, in Oberade, the Bodensee and in Alsace. Tremors were felt in Switzerland, most strongly in the cantons of Schaffhausen and Thurgau. The earthquake was apparently preceded by a foreshock, which was felt at places in south-west Germany including Frankfort-on-Main ; but this foreshock was not recorded with any intensity in England. The main shock was also recorded at West Bromwich, on the seismograph belonging to Mr. J. J. Shaw.

The Franklin Institute : Medal Awards

THE following medals of the Franklin Institute, Philadelphia, were awarded on April 21 : *Franklin Medal and Honorary Membership* to Prof. Harold C. Urey, professor of chemistry in Columbia University, for his discovery and production of heavy hydrogen, which has proved of immense importance in furthering research in chemistry, physics, and biology ; and to Dr. George Washington Pierce, for his development of "electrically squeezed" quartz crystals used to narrow the range of radio frequencies. The use of this principle in obtaining accurate oscillations has facilitated the construction of the most precise electric clocks. *Elliot Cresson Medal* to Prof. Charles M. Allen of Worcester Polytechnic Institute. His contribution to the field of hydraulics is a more rapid method of measuring the flow of water by adding a known amount of salt to the water and noting the time required for it to pass electrodes inserted in the pipe lines down-stream.

Howard A. Potts Medal to Dr. Don Francisco Ballen for restoring a valuable natural resource of his country to productivity ; and to Dr. Paul R. Heyl of the National Bureau of Standards for his theoretically important formula to determine the constant of gravitation. *Frank P. Brown Medal* (for achievements in building and allied industries) posthumously to Mr. Albert Kahn, Detroit architect. *Edward Longstreth Medals* (jointly) to Mr. Robert Griffin De La Mater and Mr. William Schwemlein. Their design and successful application of a fluid brake has made practical the drilling of wells to great depths, with increased safety to life and property. *John Price Wetherill Medal* to Robert Howland Leach. *George R. Henderson Medal* to Harry Miller Pflager, senior vice-president of the General Steel Castings Company. *A Certificate of Merit* to Carl S. Hornberger. The 1943 *Louis Edward Levy Medal* (for the best paper published in the *Journal of the Franklin Institute* during 1942) to Anders Henrik Bull of Forest Hills, N.Y., for his paper, "Soil Pressure Distribution along Flexible Foundations".

Institution of Electrical Engineers

IN collaboration with the British Red Cross Society arrangements were made by the Institution of Electrical Engineers for British prisoners of war in Germany to sit for the associate membership examinations held in May and November, 1942. There were nineteen such candidates who took the examination, or parts thereof, on one or other of the two dates, seven of whom were successful in passing Parts I and II, three in passing Part I only, and one Part II only. Five others passed in single subjects, a special concession having been granted to prisoners of war to take one subject at a time if they so desired. A commendably high standard of marks was reached by the candidates. Seventeen candidates in Germany entered for the May 1943 examination.

ASLIB Training Course in Special Librarianship

OWING to the fact that many skilled and experienced librarians have been called up for various forms of national service, there is now great difficulty in operating special libraries and information bureaux to the required standard of efficiency with the untrained and inexperienced assistant staff available. To meet this difficulty, the Association of Special Libraries and Information Bureaux (ASLIB) organized an emergency course of training during the spring of 1943. This has proved to be such a success that the course is being repeated in the autumn and, in addition, an intensive course is being given as a week's summer school (August 9–14) for those who, because of distance or other reasons, cannot attend weekly lectures. The fee for the course is five guineas. Applications to attend should be made as soon as possible to ASLIB, 31 Museum Street, London, W.C.1.

Summer School in X-Ray Crystallography

A SUMMER school in X-ray crystallography applied to industrial problems is being arranged by the Departments of Physics and of Mineralogy and Petrology in co-operation with the Board of Extra-mural Studies of the University of Cambridge, and will be under the direction of Dr. W. A. Wooster, University lecturer in the Department of Mineralogy and Petrology, and of Dr. H. Lipson, assistant in experimental research in crystallography. The number of practical applications of X-ray crystal analysis in industry has greatly increased, and it is quite probable that the usefulness of X-ray crystallography in the solution of industrial problems is not fully appreciated by technical men attached to industrial organizations. There is a growing need for the proper training of such technical men in this type of work, even though a working knowledge of it may have been acquired already. The chief aim of the summer school will be to give a training in the fundamentals of the subject, to bring workers into touch with the wide range of methods used, to teach them the newest techniques, and to indicate the many types of industrial problems in which this work can be used with advantage. Emphasis will be laid on practical work both with apparatus and in the interpretation of various kinds of X-ray photographs. The course is designed to extend from September 6 until September 18, but it will be possible to attend for either week only. In view of the present shortage of staff, apparatus and materials, the numbers attending the school will be limited; application to attend must be made before July 26. Further information can be obtained from the Secretary of the Board of Extra-mural Studies, Stuart House, Mill Lane, Cambridge.

University of London

THE title of professor emeritus of the history of medicine in the University of London has been conferred on Dr. Charles Singer on his retirement from the professorship of the history of medicine at University College.

The degree of D.Sc. has been conferred on Mr. F. R. Goss (Imperial College of Science and Technology); Mr. S. H. Harper (Imperial College of Science and Technology); Miss Emmy Klieneberger (Lister Institute of Preventive Medicine); Mr. W. T. Russell, a 'recognised teacher' at the London School of Hygiene and Tropical Medicine; Mr. T. E. Wallis, reader at the College of the Pharmaceutical Society, London.

Physical Society: Charles Chree Medallist

THE Charles Chree Medal and Prize are provided by the income from a fund given to the Physical Society in 1939 by Miss Jessie S. Chree, of Edinburgh, in memory of her brother, Dr. Charles Chree, a former president of the Society and superintendent of the Kew Magnetic Observatory. The Prize and Medal are awarded biennially in recognition of distinguished research in terrestrial magnetism, atmospheric electricity or cognate subjects, in which Dr. Chree was specially interested. The Council of the Society made the first award to Prof. Sydney Chapman in 1941 for his work in the first of these fields. The Medal and Prize for 1943 have been awarded to Prof. (now Brigadier) Basil F. J. Schonland, director of the Bernard Price Institute of Geophysics, Johannesburg, in recognition of his valuable researches in the second field (see NATURE, February 20, p. 218). The presentation will be made at a meeting of the Society at the Royal Institution on July 16, when Brigadier Schonland will deliver the second Charles Chree Lecture, taking as his subject "Thunderstorms and their Electrical Effects".

Announcements

IN accordance with the terms governing the appointment of the Parsons Memorial lecturers, the lecture for 1943 is to be given under the auspices of the Physical Society. It will be delivered early in the autumn by Lord Rayleigh. The date and further particulars will be announced in due course.

THE governing body of the Imperial College of Science and Technology has elected to Imperial College fellowships the following old students of the college: Dr. F. W. Lanchester, Dr. J. G. Lawn, Dr. F. C. Lea, Mr. F. Twyman, and Mr. H. G. Wells.

DR. R. R. MIMMS has been appointed lecturer in physics in the University of Birmingham to succeed Dr. Guy Barlow, who is retiring after forty years service. Dr. P. B. Moon has been given the title of reader in atomic physics.

THE University of Aberdeen has conferred the honorary degree of LL.D. on Prof. D. M. S. Watson, Jodrell professor of zoology and comparative anatomy, University College, London. The degree of D.Sc. has been awarded to W. Burns, for a thesis on "An Oscillographic Study of the Activity in Nerves associated with the Viscera"; and on Dr. R. D. Stuart, for a thesis on "A Study of Leptospirosis in the South-West of Scotland with special reference to Laboratory Investigation, Epidemiology and Specific Prophylaxis".

DR. W. E. LE B. DIAMOND, assistant secretary of the Institution of Gas Engineers since 1937, has been appointed general manager of the British Plastics Federation.

APPLICATIONS for the conditions of the competition for the Jones-Bateman Cup offered triennially for original research in fruit culture which has added to our knowledge of cultivation, genetics, or other relative matters, may be had on application to the Secretary, Royal Horticultural Society, Vincent Square, Westminster, London, S.W.1.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Biological Research in the West Indies

At present, considerable interest is being evinced about development of the Colonies of the British Empire, particularly the West Indies. Plans have been, and probably still are being, made for utilizing the resources of the West Indies.

In 1939 I had the privilege of leading a strong scientific expedition to Jamaica and I returned with an idea which was shelved with the advent of war. In view, however, of the active developments now taking place, it would seem a proper moment to translate the idea into words. The Imperial College of Tropical Agriculture in Trinidad provides all that is required for training purposes in agriculture, forestry and animal husbandry, but the College is not intended to provide extensive facilities for general research in pure botany and zoology. A marine station exists in Bermuda, but it has, I believe, been closed for some years. In addition, there is the Carnegie marine station in the Tortugas, and a station under the control of Harvard University in the Panama zone.

The West Indies in peace-time are about our most accessible sub-tropical Colony, with a good service of boats and an excellent climate. The building of a tropical research station in this part of the globe would seem to be long overdue. At present most of the research work is being carried out by scientific workers from American universities, and while it may be agreed that the Caribbean is more truly their province, nevertheless the British West Indies look to Great Britain as their fountain-head. The present position, therefore, has many features which are to be deplored; but I believe that they could easily be rectified.

The proposed scheme envisages the building of a tropical research station in Jamaica, which it is hoped would be financed and controlled by a joint committee drawn from the staffs of British universities. The essential part of the scheme is the provision of special facilities and courses for undergraduates from any of the British universities. These courses would have to take place during the long vacations. It is hoped that shipping companies would provide concessions for such parties of students. Arrangements could also be made for members of the permanent staff to exchange for a year with biological lecturers from contributing universities, to the mutual advantage, it is hoped, of both. The station would have to combine research with teaching, and the staff would therefore be under an obligation to assist any of the West Indian schools. Courses comparable to those at Plymouth, Port Erin, Millport, would be arranged for senior schoolchildren during the shorter holidays at Christmas and Easter.

The research programme of the station would deliberately avoid problems in agriculture or animal husbandry, though it would certainly include fishery problems. The staff would be expected to devote themselves to research in pure botany and zoology: numerous problems are available in both these subjects. The proposed station could be described most satisfactorily as a combination of the marine laboratory at Plymouth and the botanical research station at Buitenzorg.

In order to provide the fullest possible scope both for research and teaching, it is suggested that the station be built in two parts, one part up in the Blue Mountains, perhaps on the disused site of the Cinchona station, or in the gardens at Castleton, while the other part would probably be best sited at Montego Bay or on the Pallisadoes. The mountain station would be under the control of a botanist and the lower one under the control of a zoologist. The distribution of staff might be arranged in the following manner:

Mountain station: Botanical director, entomologist, zoologist (reptiles and amphibians) and geneticist.

Lower station: Zoological director, oceanographer, algologist, marine zoologist and fishery expert.

In addition, there might be a floating staff consisting of a geologist, ecologist, mycologist, plant systematist, physiologist and experimental zoologist who would work at either station depending on their current problems. The number of these required would depend upon the scientific interests of the two directors.

It would be desirable for the Hope and Castleton gardens to come under the control of the botanical director, subject to the approval of the Government of Jamaica.

It is fully realized that this scheme is ambitious, and even if it is approved and started the complete staff might not be available for some time. In extenuation it may be pleaded that boldness at the outset is more likely to secure ultimate success. It might prove desirable that the Government of Jamaica, acting directly or indirectly, should contribute financially, but a fundamental part of the scheme is control by the British universities committee. Further discussion might indicate a desire from some of the Canadian universities to co-operate, and there are other details that remain to be worked out. The station is not intended to be a small technical university, nor is it meant to compete in any way with the Imperial College of Tropical Agriculture in Trinidad. A close liaison would inevitably exist between the station and the Institute of Jamaica.

The provision of such a station would give a great stimulus for research in the Caribbean and also at the same time an opportunity for future generations of scientific workers from the British Isles, Canada and the West Indies, to obtain at first hand knowledge of plants and animals which at present can only be provided by text-books.

Universities and Government are unlikely to approve finance for such a scheme at present, but if approval in principle is now given the details could be worked out and erection of the station could commence at the first favourable moment.

Broompark,
Oban, Argyll.

V. J. CHAPMAN.

Ribonucleic Acids in Animal Tissues

The original view that ribonucleic acids (yeast nucleic acid, phytonucleic acid) are to be found exclusively in plant tissues, and desoxyribonucleic acid (thymonucleic acid, animal nucleic acid) exclusively in animal tissues is now known to be no longer tenable.

Apart from the ribose mononucleotides and dinucleotides which are known to play an important part in the metabolism of animal cells, ribopolynucleotides (nucleic acids) have been detected histochemically in animal tissues[1], and one such ribonucleic acid has been isolated from mammalian pancreas[2]. Moreover, desoxyribonucleic acid has been reported in yeast cells[3] and in plant tissues[4]. Both types of nucleic acid are present in bacteria[5].

Evidence is accumulating that both in the plant cell[6] and in animal cells[7] desoxyribonucleic acids are to be found in the nucleus and ribonucleic acids mainly in the cytoplasm. Ribonucleic acids may also form, especially in active cells, a small proportion of the nucleic acid of the nucleus[8] where thymonucleoprotein associated with the structure of the chromosomes predominates[9]. The nucleolus is composed of ribonucleoproteins[10] and is claimed to be associated actively with the synthesis of the cytoplasmic ribonucleic acids or nucleotides which are especially abundant at the nuclear membrane. These ribonucleic acids may also form part of the mitochondria[11], which appear to be phospholipid-ribonucleoprotein complexes. Such complexes of phospholipid with nucleoprotein containing ribonucleic acid are found in adult liver[11], in normal embryonic tissue[12], in embryo and adult brain[13], in equine encephalomyelitis virus[14] and in the active fraction of tumour-producing sarcoma extracts[15].

The biological activity of the ribonucleic acids has also been emphasized by their presence in plant viruses such as tobacco mosaic virus[16] and in the tissue growth-promoting factor of embryo juice[17], and by recent reports of high concentrations of ribonucleotides in the cytoplasm of cells in which rapid protein synthesis is taking place[10], including embryonic tissues, in tumour tissues[18], in the cytoplasm of proliferating and differentiating cells exposed to X- and gamma-radiation[19], and in the intercellular fluids from injured cells[20].

We have recently demonstrated, using chiefly tissues from the adult and embryo sheep, that ribonucleic acids (ribopolynucleotides) are widely distributed in surprisingly high concentrations in mammalian tissues. After removal of lipoid and acid-soluble phosphorus (including simple nucleotides), the tissue residue was extracted with cold and then hot 10 per cent sodium chloride to remove the nucleic acids, which were then precipitated as lanthanum salts and the precipitate analysed for pentose and desoxypentose. As evidence based on pentose estimations alone may not be in itself conclusive, the occurrence of ribonucleic acids has been confirmed enzymatically by treating portions of the sodium chloride extract with crystalline ribonuclease[21], which attacks ribonucleic acids only, and estimating the amount of nucleic acid phosphorus split off by the enzyme.

As the accompanying table shows, in most cases the total nucleic acid content, as measured by nucleoprotein phosphorus estimations, is considerably higher in the embryo than in corresponding adult tissues. The ratio of ribonucleic acid phosphorus to desoxyribonucleic acid phosphorus is, however, either of the same order in the embryo as in the adult or is slightly higher in the adult. Although the absolute amount, therefore, of both types of nucleic acid is much higher in most embryonic tissues than in the corresponding adult tissues, in any given tissue the amount of ribonucleic acid relative to the amount of thymonucleic acid remains the same in the adult as in the embryo or may be slightly greater in the adult.

The results also support the view that desoxyribonucleic acids are found in the nuclei and ribonucleic acids mainly in the cytoplasm. The ratio is very low (0·18) in the case of the isolated nuclei of embryo liver. Moreover, saline extracts of minced shee embryo with powerful growth-promoting propertie to fibroblasts cultivated *in vitro* have a much highe ratio (9·1) than any of the individual tissues. Such extracts would be expected to contain cytoplasmic rather than nuclear material[7]. This high ratio may throw light on Fischer's[17] claim that the growth-promoting activity of embryo juice is associated with the ribonucleoprotein fraction.

COMPARISON OF TISSUES OF ADULT SHEEP AND 9–10 WEEK SHEE EMBRYO.

Tissue	Nucleoprotein phosphorus % dry wt.		Ratio ribonucleic acid phosphorus / desoxyribonucleic acid phosphorus in precipitate of La salts	
	Adult	Embryo	Adult	Embryo
Liver	0·25	0·55	3·5	2·5
Lung	0·43	0·76	0·9	0·7
Gut	0·52	0·68	1·0	1·1
Heart	0·12	0·49	2·8	2·8
Spleen	0·60	0·64	0·5	0·6
Kidney (cortex)	0·34	0·65	1·9	1·0
Brain	0·19	0·24	2·1	2·3
Muscle	0·09	0·36	3·6	1·4
Testis	0·42	—	2·6	—
Thyroid	0·10	0·42	2·0	1·1
Thymus	—	1·06	—	0·2
Pancreas (ox)	—	—	8·0	—

The evidence so far obtained indicates that animal tissues in general contain appreciable amounts of pentose nucleic acid (presumably ribonucleic acid) which can act as substrate for the enzyme ribonuclease. Whether its structure is similar to that of the ribonucleic acid of yeast, or more probably to that of the ribonucleic acid of the pancreas, is not yet known.

Our grateful thanks are due to Dr. Kunitz for a specimen of crystalline ribonuclease, and to the Carnegie Trust and the Medical Research Council for grants.

Physiology Department,
University of Aberdeen.
June 9.

J. N. DAVIDSON.
C. WAYMOUTH.

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Inhibition of Urease Activity by Ascorbic Acid

ASCORBIC acid has been found to have a marked inhibitory effect on urease activity. With some preparations of the enzyme, the formation of ammonia from urea is completely inhibited by a concentration of one part ascorbic acid in 200,000, and 50 per cent inhibition is obtained with one part ascorbic acid per million. The inhibition is prevented by addition of cysteine.

The urease preparation used was obtained by shaking 0·2 gm. Arlco-Jack bean meal with 18 ml. distilled water and centrifuging. 0·5 ml. of the urease, 3 c.c. acetate buffer *p*H 5·0, ascorbic acid and cysteine hydrochloride added as 0·1 per cent solutions, and water to make a volume of 8·3 ml. were kept at 45° C. for half an hour, and then 1·7 ml. of 3 per cent urea solution added, to give a total volume of 10 ml. The ammonia formed was estimated colorimetrically with Nessler's reagent, using a Hilger 'Spekker' photo-electric absorptiometer.

EFFECT OF ASCORBIC ACID ON UREASE ACTIVITY.

Ascorbic acid	Concentration of ascorbic acid	Ammonia formed in 60 minutes
0·0 (Control)	—	13·4 mgm.
1·0 mgm.	1 in 10,000	0·0 ,,
0·1 ,,	1 ,, 100,000	0·0 ,,
0·05 ,,	1 ,, 200,000	0·0 ,,
0·02 ,,	1 ,, 500,000	3·2 ,,
0·01 ,,	1 ,, 1,000,000	6·2 ,,

EFFECT OF CYSTEINE AND ASCORBIC ACID ON UREASE ACTIVITY

Ascorbic acid	Cysteine hydrochloride	Ammonia formed in 60 minutes
0 (Control)	0·0 mgm.	10·9 mgm.
0	2·0 ,,	10·9 ,,
1 mgm.	0·0 ,,	0·0 ,,
1 ,,	2·0 ,,	13·3 ,,
1 ,,	1·0 ,,	11·5 ,,
1 ,,	0·5 ,,	10·9 ,,
1 ,,	0·2 ,,	7·2 ,,
1 ,,	0·1 ,,	6·9 ,,
1 ,,	0·05 ,,	2·3 ,,
1 ,,	0·01 ,,	1·7 ,,

My thanks are due to I.C.I. (Dyestuffs), Ltd., for permission to publish this letter.

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Mechanism of Polysaccharide Production from Sucrose

IT has been shown that suitable bacterial cell extracts may act on sucrose with formation of a polyglucoside, dextran[1,2], or of a polyfructoside, levan[3]. As instances of enzyme-mediated polymer syntheses *in vitro*, these reactions command wider interest than would necessarily alone be merited by the functional importance of levan and dextran in microbe and plant metabolism. The enzymes responsible for production of levan and dextran from sucrose will conveniently be designated, in accordance with the substrate requirement and reaction end-product of the enzyme agent employed, respectively as levansucrase and dextransucrase. It is the former enzyme, as it appears in autolysate fluid of a selected Aerobacter strain[3], which is the subject of the present communication.

Levansucrase acts on sucrose or raffinose with production of levan and reducing sugar. All other substrates so far tested, including, in addition to common hexoses and disaccharides, several substrates with a terminal fructofuranoside group, namely, Neuberg ester, Harden-Young ester, methyl gamma fructoside, and inulin, failed to support levan production[4].

In its general properties, levansucrase is not unlike an ordinary carbohydrase. Its solutions are stable for months if kept on ice; when boiled they are immediately inactivated. The enzyme shows optimal activity at *p*H 5·5. It develops half-maximum synthesis velocity on sucrose concentrations between 0·02 and 0·06 molarity, the exact point depending on the enzyme lot. Glucose retards levan production to an extent dependent on its concentration relative to sucrose; fructose, on the other hand, is completely non-retarding. Dialysis of the enzyme does not affect its activity as measured in citrate buffer on sucrose.

It has been shown that levan production from sucrose and raffinose can be described by a common formula:

$$(n + m).\text{aldosido} <> \text{fructofuranoside} + n.\text{H}_2\text{O} \rightarrow (m+n).\text{aldose} + n.\text{fructopyranose} + [\text{levan}] \quad . \; . \quad (1)$$

where aldose is either glucose or melibiose, depending on whether sucrose or raffinose is the substrate employed, m and n are whole numbers experimentally determined, and where [levan] represents m residues of fructofuranose polymerized to molecules of levan.

Galactose is not liberated by the enzyme from raffinose concomitantly with levan production. As is implicit in (1), therefore, production of levan from raffinose cannot be regarded as proceeding via intermediately formed sucrose.

The ratio m/n characterizes the synthesizing efficiency of sucrose conversion by the tested enzyme system. Its magnitude varied, depending on the conditions of the experiment and on enzyme lot, between 0·7 and 1·6.

Levan production does not proceed unchecked in the direction indicated in (1). After an initial rapid advance, it is progressively slowed. On adequate sucrose amounts, and using cell-free soluble levansucrase as synthesizing agent, levan production always came to a stop once the concentration of levan was between 300 and 500 mgm. per cent, the value being variable within these limits with enzyme lot. New simultaneous addition of enzyme and sucrose to mixtures in which levan production had come to a stop failed to renew the synthetic process.

It should be observed that the measured end-point is not one of mass equilibrium between the saccharide reactants noted. Increase in the initial concentration of sucrose beyond a necessary minimum does not bring about a shift in the position of the levan end-point. Moreover, reversal of the direction of the enzyme's activity has not so far proved feasible. Although intact cells of the selected Aerobacter strain are themselves able to ferment levan slowly, soluble cell-free levansucrase preparations failed completely to act either on levan alone or on mixtures of levan and glucose in any chemically evident way.

Balance sheet experiments revealed no drop in total carbohydrate content during levan production *in vitro*. Furthermore, known poisons of respiration or of glycolysis, namely, cyanide, fluoride, monoiodoacetate, and phloridzin, failed to suppress or even markedly to retard levan production. One may conclude, therefore, that equation (1) states fully the *net* result of the action of Aerobacter autolysate on sucrose. Conceivably, levan production is linked energetically or otherwise with sucrose hydrolysis, from which, indeed, it has not yet proved separable. Clearly, however, it is not so linked with energy-yielding desmolytic transformations of sugar.

In conclusion, it is relevant to emphasize that the specificity characteristics of levansucrase, as reported above, run counter to the theory of levan production advanced by Hibbert and his school[4]. They fail, in fact, to conform, as will be detailed elsewhere, with any one of the established general systems of carbohydrase specificity[5].

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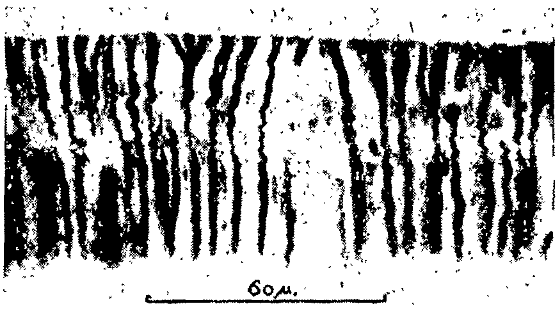
Pore Canals of the Insect Cuticle

IT has been suggested from time to time that the pore canals of the insect cuticle offer an important channel for the entry of contact insecticides, and Wigglesworth[1], working on the bug Rhodnius, in which the canals contain protoplasmic filaments, or perhaps fluid, has recently given additional evidence in favour of this view. But Richards and Anderson[2], as a result of their electron microscope studies of the cockroach cuticle, believe that the pore canals are filled by a watery fluid and not by protoplasm, and that oil-borne insecticides cannot penetrate by this route. Among earlier writers Holmgren[3], Plotnikow[4], and Berlese[5] have expressed the view that although the canals are occupied by protoplasm during early growth of the cuticle, they are later filled by some cuticular substance. If this is so, they would appear scarcely likely to be involved in insecticide penetration.

Although Wigglesworth[6] has rightly pointed out the slender basis on which the theory of cuticularization of pore canal contents rests, consisting of nothing more than the staining of the contents with such dyes as eosin and Congo red, and has shown that on drying the cuticle of Rhodnius the canals become filled with air, I have recently, during a study of the cuticle of Dipterous larvæ, had evidence that in some insects at least pore canals may be transformed into solid structures.

The third-stage larva of *Sarcophaga falculata* possesses pore canals which on account of their large size are readily observed. In an early larva of this stage, they extend completely through the thin (10 μ) endocuticle. They show the tufted form illustrated by Plotnikow[4] for the canals of the caterpillar of *Bombyx mori* and of a Syrphid larva, and stain readily with eosin. In a larva one day older, the canals appear single and almost straight, with no terminal branching, and pass through only about th inner one-third of the now thicker (35 μ) endocuticle Still later, no structures staining with eosin can b detected in the endocuticle, but in their stead rod like bodies with no different staining reaction from the now very thick (60–140 μ) endocuticle are faintly visible.

It seemed probable that these rods are cuticular structures derived from the cytoplasm of the pore canals, and accordingly larvæ of progressively in creasing age were heated with caustic potash, sec tioned, and treated with iodine as a specific test for chitin in the manner described by Campbell[7]. In the early larva, in which the tufted pore canals stain with eosin, *no positive reaction took place*. In larvæ one day older, only the outermost parts of the canals assumed a deep violet, while in the still older larvæ, in which no structures are revealed by eosin, the whole extent of the canal assumed a deep violet coloration, deeper than that of the surrounding endocuticle, and even more indicative of the presence of chitin. The form of the pore canals was thus clearly revealed, as shown in the accompanying photograph.



SECTION THROUGH THE CUTICLE OF THE THIRD-STAGE LARVA OF SARCOPHAGA, TREATED WITH CAUSTIC POTASH AND IODINE TO DEMONSTRATE THE DISTRIBUTION OF CHITIN. THE PORE CANALS GIVE AN INTENSE POSITIVE REACTION.

It appears then that, although chitinization of pore canal contents may take place in some insect cuticles, those who accepted the coloration of the canals with eosin and similar stains as evidence of this were in error. Chitinization of the contents of the canals takes place later than in the stage illustrated by Plotnikow[4], and proceeds inwards from the distal ends of the canals. Whether it takes place by secretion of chitin from the tips of the receding protoplasmic filaments, or by bodily conversion of the filament itself, is not clear.

Further evidence of the solidity of the contents of the canals is provided by splitting the cuticle horizontally into two sheets, when the chitinous strands are clearly visible as solid rods projecting from the inner face of the outer sheet.

The form of the chitinized pore canals is similar to that of the open canals of the cockroach described by Richards and Anderson[2], but differs in showing terminal splitting—a result of the form of the canals of the early larva. In the photograph many of the canals appear unduly thick owing to the tight coiling of the helix. Some fifty to seventy canals are associated with each hypodermal cell, giving a density of distribution of the order of 15,000 per sq. mm. The smaller canals of the cockroach are much more numerous, occurring at the rate of 1,200,000 per sq. mm.

In connexion with the penetration of insecticides hrough the cuticle, one point remains to be menioned. The ease with which the contents of the anals are revealed by splitting the cuticle indicates hat there is no fusion between them and the surounding endocuticle ; indeed there may exist around ach filament a small annular space which might well e involved in insecticide penetration.

In conclusion, it should be stated that the cuticle f the Cyclorrhaphous third larval instar is probably pecialized in connexion with its ultimate conversion nto the puparium, and that chitinization of pore anal contents may not be of widespread occurrence. Nevertheless, a renewed examination of the cuticles f a number of diverse insects would be of interest.

A full account of the work of which these results orm a part will be given later.

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The Term *Tractellum* in Flagellate Organisms

In the latest number of the *New Phytologist* an rticle appears under the heading of "Recent Work n Flagellar Movement", by D. Barker of the Deartment of Zoology and Comparative Anatomy, Oxford[1].

Though there is considerable difference of opinion pparently on the structure of flagella or cilia there is now no difference of opinion on one fundamental point, and that is that the waves or disturbances start at the base of the flagellum and not at the tip. This being so there can be no such thing as a tractellum. The whole misconception originated so far as I can gather with the flagellum of *Peranema trichophora* (Ehrbg.) Stein, as described and figured by Verworn[2].

Direct photographic evidence, taken from the high-speed cinema film, that the waves start at the base of the flagellum of Peranema and not at the tip was given in NATURE so long ago as 1936[3]. We know that in all cilia lining epithelial structures so far investigated, and also in the frontal and abfrontal cilia or flagella on the gills of Mytilus or Modiolus, the waves start at the base, and the same is true for all sponges so far as we know. Finally, the same has been shown to be true for more than a dozen different species of flagellates, and there is no direct evidence of it starting from the distal end.

It seems, therefore, highly desirous that the term *tractellum* should disappear from all text-books, elementary or otherwise, until direct photographic evidence of its existence is produced.

In the majority of flagellates the flagellum or flagella are attached to the anterior end of the cell, but to use an apt expression of a colleague, the organism is not *pulled forward by its hair but it is pushed forward by its nose.*

Actually the anterior end of the cell is pushed round by the flagellum and the whole cell thus made to rotate and gyrate about a given axis, and this of itself is sufficient to supply a forward component on the simple mechanical principle of the inclined plane.

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How the Sperm Reaches the Archegonium in *Pellia epiphylla*

In text-books on botany *Pellia epiphylla* (L.) Corda is very often chosen as an example of the liverworts, and hence any information about its structure and biology is of interest. It has no doubt been chosen because it has, in comparison with the majority of liverworts, a relatively massive gametophyte and a large sporophyte ; it is also a widely distributed and common plant.

It is usually assumed that the sperm swims by means of its two flagella from the antheridium to the archegonium, which contains the ovum. The archegonia are, however, placed at the apex of the plant and the nearest antheridia are 5–10 mm. distant on the dorsal surface. Showalter has shown that free sperms in a closely related genus (Aneura) may take several hours to spread a distance of 10 mm. In previous investigations[1] it was found that in many mosses and liverworts it was the spermatocytes, each of which contains a single sperm enclosed in a membrane, which were liberated from the antheridia, and that these were carried rapidly by the agency of surface tension over the free water surface at a rate of about 20 mm. per minute.

In June 1943 plants with ripe antheridia were taken and their upper surfaces wetted. The spermatocytes were seen to be extruded in grey masses into the water, and when these reached the surface their spermatocytes were seen to break apart and disperse over the wet surface with great rapidity. The spermatocytes reached the archegonial involucre in about fifteen seconds. It takes about fifteen minutes for the free, swimming sperm to emerge from the spermatocyte, so that from the time of opening of the antheridium only a little more than fifteen minutes would elapse before free, swimming sperms were at the archegonia. If the transport of a sperm from an antheridium to an archegonium depended on its swimming powers alone, it would take several hours for it to reach the archegonium, and in that time the wet surface of the thallus might become dry.

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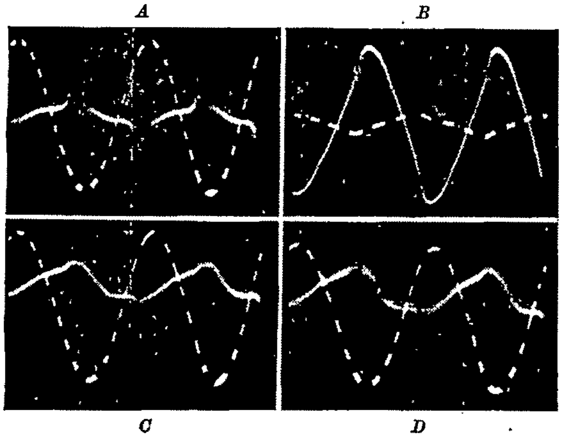
A New Method of Electrical Testing, Applied to Insulated Wires

A DIFFICULTY was experienced recently in carrying out some electrical tests on enamelled wires at temperatures up to about 120° C. Pairs of wires were twisted together in accordance with B.S.

Specification 156, Appendix A, and although it was possible to obtain all the required electrical properties at atmospheric temperatures, this was not so with some classes of enamel when the same tests were attempted in rising temperatures. As changes in power factor were being followed, a relatively high voltage between wires was used (about 1·2 kV.), and it was found impossible to avoid premature breakdown of some classes of enamel when the temperature was raised rapidly. Evidently a means of controlling the voltage applied between wires was wanted so that as the temperature rose, the voltage would fall off; but it was not practicable to do this accurately and quickly enough with ordinary hand control.

Automatic voltage control was satisfactorily achieved by replacing the test transformer then in use by another having an extremely poor regulation. By this means the enamels which had hitherto broken down prematurely caused an increasing drain on the transformer as the temperature rose, this being followed concurrently by a drop in voltage.



By connecting voltage and current leads to a double-beam cathode ray oscillograph with the usual 180° phase shift, it was thus possible to follow changes in power factor with changes of temperature as rapid as 100° C. per second, the required voltage regulation being entirely automatic. Oscillograms *A* and *B* represent conditions at 20° C. and 120° C. respectively, using an enamel sensitive to temperature; *C* and *D* are those for an enamel which shows little sensitivity to temperature. For clarity all voltage curves are shown dotted, and the interchange of current and voltage magnitudes in the former case is thus shown very clearly. The 'haze' at the peaks of the current wave in oscillogram *A* depicts a high-frequency discharge consequent upon the high voltage used, and this is naturally absent in oscillogram *B*, which illustrates a much lower voltage. This high-frequency discharge appears to be a characteristic of those enamels which are sensitive to temperature.

The change from condition *A* to condition *B* is not a chemical one, and on the oscillograph the gradual change from one extreme to the other could be observed any number of times as the temperature was raised and lowered.

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Biological Control of the Fly Populatio in Sewage Filters

In his communication on "Town Planning and th Small Sewage Purification Plant", Dr. Lloyd[1] discusses the problem of controlling the numbers of th sewage fly, *Anisopus fenestralis*, in and aroun sewage filters close to housing estates. Thoug Psychoda flies were also present in large numbers i these filters, they apparently caused little nuisanc compared with that from the Anisopus flies, whic entered the neighbouring dwellings in large numbers

For the past two years observations have bee made, as part of the programme of the Water Pollution Research Board of the Department of Scientifi and Industrial Research, of the seasonal variatio in the fly population in large-scale percolating filter at the Minworth works of the Birmingham Tam and Rea District Drainage Board. The results sugges a possible answer to the question raised by Dr. Lloyd

The four filters under observation at Minwort have a varied fauna composed mainly of *Psychod alternata*, *Anisopus fenestralis*, *Achorutes viaticus*, an Enchytræid worms. It was found that unde optimum conditions of growth, *Anisopus fenestrali* took 121, 73, 50 and 39 days at 9° C., 13° C., 18·5° C and 21° C. respectively to complete its life-cycle With a restricted food supply, however, the duratio of the life-cycle may be much longer than is indicate by these figures. Whereas *Psychoda alternata* i restricted to the warmer months[2], the temperatur of the filters is normally favourable throughout th year for the development of Anisopus. The filter therefore carry during the winter months a larg potential population of flies which emerge in th spring if weather conditions and conditions in th filters are favourable. If the surface layers of th filters are open, Anisopus emerges in large number during periods of warm weather in the spring. Th numbers decline in the late spring and early summer when *Psychoda alternata* begins to breed in larg numbers in the filters.

At summer temperatures it appears that *Psychod alternata* is more effective than Anisopus as a scourin organism. Under certain conditions the accumulatio of solid matter in the upper layers of a filter may b sufficient in amount to prevent the emergence o Anisopus without impairing the efficiency of th filter by causing serious ponding on the surface Such conditions may prevail in the spring in filter operated at high rates as alternating double filter with a short period of alternation, or in a filte treating a mixture of sewage and effluent at a hig rate. The emergence of large numbers of Anisopu in the spring is thus prevented. The filters at Minworth became cleared of solid matter by summe owing to the scouring activity of Psychoda. Numerou Psychoda but few Anisopus emerged from thes filters during the summer.

The successful competition of Psychoda wit Anisopus in these filters is a good example of natura biological control, and the observations recorded suggest another line of approach to the problem raised by Dr. Lloyd, which is consistent with th operation of filters at their maximum capacity.

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TREATMENT OF CANCER BY FAST NEUTRONS

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TONE AND LARKIN[1] have recently reported upon their experience, over a period of two ears, in the treatment by fast neutrons of 120 atients with advanced 'incurable' cancer in various ites. The neutrons were generated by the 60 in. yclotron at the Crocker Radiation Laboratory, San rancisco. They were able to demonstrate both linically and pathologically that some tumours disppeared as a result of neutron therapy, and their eport, which is presented with admirable clarity nd restraint, is on the whole encouraging. We wish o comment upon the possible influence of the energy f individual neutrons, both incident and at a depth n the body, on the results obtained.

It has now been established beyond all doubt that he biological effect produced by ionizing radiations lepends not only on the total ionization produced vithin the cell (the tissue dose) but also on the spatial distribution of these ions. The latter parameter may be expressed numerically by the average umber of ions formed per micron of track of the onizing particles within the cell, and varies from 10 n the case of γ-rays to 40 for 200 kV. X-rays, about 00 for neutrons (see below), up to 4,000 for α-particles. (The mean density of ionization along the track of uranium 'fission' fragment is about 130,000; but the biological effects of these particles have not so far been studied, though such experiments seem feasible in certain cases.)

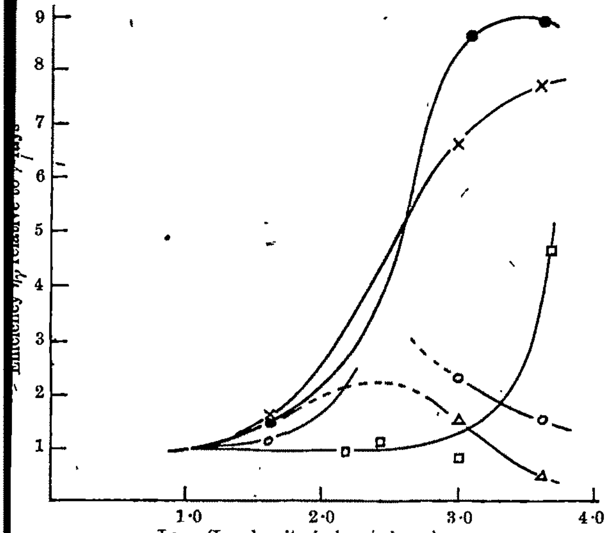

Fig. 1. BIOLOGICAL EFFICIENCY AS A FUNCTION OF LOG$_{10}$ (ION DENSITY).

□ Disinfection of spores of *B. mesentericus* (ref. 9).

○ × Two types of chromatid injury induced in the microspores of *Tradescantia bracteata* by irradiating during prophase. ○ Simple chromatid breaks. × Isochromatid breaks (ref. 14 and unpublished data obtained by Kotval, and Kotval and Gray).

△ Inhibition of mitosis in roots of *Vicia Faba* (Gray, Mottram, and Read, unpublished.)

● Lethal effect on roots of *Vicia Faba* (ref. 18).

Most of the determinations of η are subject to an uncertainty of the order of 10–20 per cent.

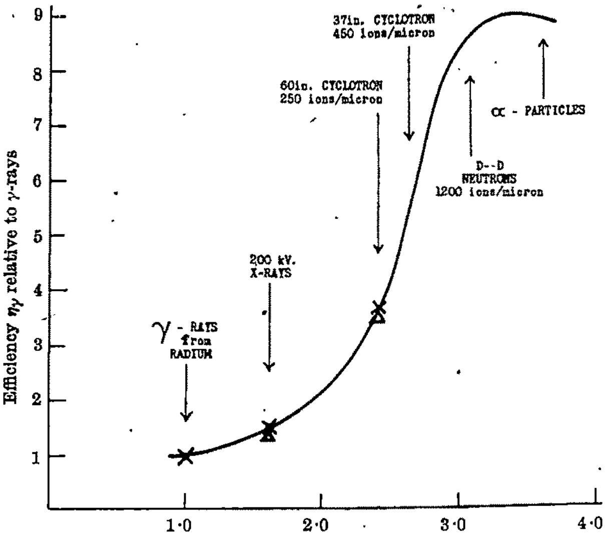

Fig. 2. EXAMPLE OF BIOLOGICAL EFFICIENCY AS A FUNCTION OF LOG$_{10}$ (ION DENSITY).

Full Curve: Lethal action on roots of *Vicia Faba* (Fig. 1 and ref. 18).
Experimental points:

× Skin reaction

$\eta_\gamma^X = 1{\cdot}5$ (ref. 24); $\eta_X^N = 2{\cdot}5$ (refs. 1, 22)

△ Lethal action on tumour tissue irradiated *in vitro*

$\eta_\gamma^X = 1{\cdot}3$ (ref. 23); $\eta_X^N = 2{\cdot}6$ (refs. 19, 22)

We may express the relative efficiency of two radiations A and B in producing a given biological reaction by the reciprocal ratio of the doses necessary to produce this effect and denote it by the symbol η_B^A. (Where published data refer to doses not measured in units proportional to the ionization per unit volume of the cell, allowance has been made for this fact in calculating efficiencies. It has been assumed that 1 n unit = 2·5 energy units[22].) It has been shown that in the case of the production of sex-linked lethal mutations in Drosophila sperm[2,3], the inactivation of a number of viruses[4–7] (under conditions which preclude an indirect action through the ionization of the aqueous medium) and the disinfection of vegetative bacteria (*B. coli*)[8,9], η decreases with increasing ion density. This decrease is capable of a simple quantitative interpretation in terms of the relation between the size of the structure inactivated and the mean distance apart of the ions[5]. On the other hand, there are many cases in which, over the range of ion density investigated, which in some cases is 10–500 ions/micron, and in others 10–4,000 ions/micron, η increases steadily with ion density. These include the production of chromosome aberrations[10–15], the inhibition of hatching of Drosophila eggs[16], the lethal effect on roots and shoots of seedlings[16,17,18], the inhibition of growth of inoculated mouse tumours irradiated *in vitro*[19], the regression of mouse tumours irradiated *in vivo*[20], and numerous other reactions listed elsewhere[21,22].

Fig. 1 shows five examples of the variation of biological efficiency with ion density, of the type under consideration. They have been chosen as being cases in which the same biological material and the same criteria of effect have been employed in irradiations covering the whole range of available ion densities. There is clearly considerable diversity in the effect of changing ion density on different types of biological response—a diversity which goes even deeper than appears from these curves, since the shape of the curve even for the production of a given type of injury in a particular entity, such as a chromosome, is different at different developmental stages in the cell cycle[10-15]. This diversity may at some future time prove valuable as an aid to the analysis of some complex reaction, such as tumour regression, into its constituent factors, but at present we are only at the threshold of a coherent interpretation of these curves. The recent successful interpretation of chromosome break data[14] may provide a starting point.

The data for tumour response are rather fragmentary. The value of η has been measured for the effect of γ-rays, X-rays and fast neutrons on mouse tumour irradiated *in vitro*[23,19,22]. From Fig. 2 it will be seen that within this limited range, tumour response closely follows the course of the curve for the lethal effect on bean roots. Further, it has been found that η_γ^N has a very large value ($\sim$ 20) for the effect of (D–D) neutrons on mouse tumour irradiated *in vivo*[20]. The bean root curve (Fig. 2) may therefore be taken as a rough guide to the probable influence of ion density on tumour response. The mean ion densities of the recoil proton tracks from neutrons generated in several ways are indicated on the figure. It is clear that these neutron beams may be expected to differ considerably in biological efficiency.

The successful treatment of a tumour does not depend on a single biological effect, but on at least two effects, the tumour reaction and the normal tissue reaction, and possibly on others.

Stone and Larkin[1] formed an estimate of the relative effectiveness of neutrons and X-rays for one important normal tissue reaction, namely, the production of a given degree of erythema of the skin. The corresponding value of η has been plotted and lies close to the same curve (Fig. 2). It is interesting to note also that they observed less severe skin reactions than expected when changing from treatment with the 37-in. to the 60-in. cyclotron, but the possibility that the difference lay in the method of dose measurement could not be excluded. Any superiority of neutrons over X-rays, however, may be taken to indicate that η is increasing more rapidly with ion density for the tumour than for normal tissue, and therefore in the light of Fig. 2 we may hazard a guess that if neutrons from the 60-in. cyclotron showed *some* superiority over X-rays, neutrons from the 37-in. cyclotron or (D–D) neutrons would show an even greater superiority. If it is desirable to retain the advantage of the high neutron intensity obtainable from the larger cyclotrons, it might be found to be of therapeutic value to slow down the neutrons somewhat by passage through wax before entering the body.

The optimum neutron energy can, of course, only be found empirically. There is no reason for believing that it will coincide with the neutron energy for which η is maximum for the lethal effect on bean roots. Indeed, should the course of the curve for $\frac{\eta\text{ (tumour)}}{\eta\text{ (normal tissue)}}$ have the shape of Fig. 1, one would probably choose to use neutrons somewhat faster than (D–D) neutrons, so that, as a result of the slowing down of the neutrons in passing through the body, an energy corresponding to the maximum value of this ratio is just reached at the site of th tumour. In this way, for equal physical doses, th skin would be less damaged because exposed to radiation of relatively lower efficiency, and at th same time the tissues deeper than the tumour woul not be excessively exposed.

When a 60-in. cyclotron is used as a source neutrons, it is likely that the skin is in a relativel favourable position, being exposed to very fas neutrons, and that the tissues deeper than th tumour, through being exposed to slower neutron are relatively more damaged (for equal doses) tha the normal tissue at the site of the tumour. This ma perhaps be the reason why Stone and Larkin observe very severe systemic reactions and diarrhœa in patient receiving radiation to the upper abdomen, though th skin, which received a very much larger dose (ionization per unit volume of tissue), was not excessivel damaged.

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ULTRA-HIGH ELECTROMAGNETIC FREQUENCIES

AT a joint meeting of the Institute of Radi Engineers and the American Institute o Electrical Engineers held on January 28, G. C Southworth explained how micro-waves are addin to the tools of the communications engineer (*Bel Lab. Rec.*, 21, No. 7; March, 1943). Briefly outlining the conquest of the frequencies, Dr. Southworth mentioned the need of television and communication in general for more and wider channel as one of the prime forces in the advance into th micro-waves. Other desirable features of the 'micro region are the small size of antennæ and their hig directivity, and the fact that the waves follow th line of sight and thus do not interfere with signal beyond their own useful range.

Some method of conducting waves from generato to antenna, and from antenna to receiver, is obviousl necessary. While ordinary insulated wires can b used through the broadcast range and beyond, i the short-wave range special attention must be give to losses in the insulation, to radiation into spac and into nearby conductors, and to the effects o uning produced by stray capacitance and inductance. The coaxial line, in which one conductor is formed nto a tube and the other is enclosed in it, is an xcellent expedient. If the central conductor is ompletely removed, it is still possible to transmit nergy down the tube, which then becomes a wave uide. If the tube is filled with insulating material, ven the outer conductor can be removed. The oaxial and the conducting tube or wave guide are he most promising of these arrangements. Compared from the point of view of attenuation losses, he coaxial line is better at the lower frequencies ; but in the micro-wave region, which is of most mportance at the moment, the wave guide has decided advantages. However, below a certain frequency—about 3 × 10^9 for the wave guide—the wave guide 'cuts off' abruptly.

Wave guides are decidedly useful for conveying micro-waves from their generator to the place where hey will be used. They contain no insulating material and so are entirely immune to moisture, while their waves can be radiated by simply flaring out the tube nto a horn. A wave guide may also be made into a resonant chamber by blocking one end with a metal plate and closing the other partially by a plate with a hole in it. By varying the length of the chamber, it can be tuned to the precise frequency desired ; with a small hole, if the chamber is ¼, 1 or 1½ of a wave-length, it will admit energy readily ; if ½, ¾ or 1¼ wave-lengths, it will repel energy, that is, be anti-resonant. Since the wave pattern in a resonator is fixed, it is possible to locate a detector at precisely he right spot in the pattern in order to obtain maximum response.

Somewhere along the frequency scale in the neighbourhood of a billion cycles per second—wave-length about one foot—micro-wave technique undergoes a marked change. Methods using the conventional go-and-return-conductor type of circuit give way to the somewhat simpler hollow pipe, or wave guide, circuit. These newer methods seem to be at their best in the centimetre wave-length range. At the longer wave-lengths, the component parts become nconveniently large. For shorter waves, it would appear that ability to manufacture small parts would become an important limitation. What the technique will be beyond this point is a matter for the future.

THE INSECTS OF GUAM

By DR. A. D. IMMS, F.R.S.

A KNOWLEDGE of the insect fauna of small but important islands is very desirable before such fauna is inevitably changed by the operations of man and species have become extinct. In certain cases this must have happened even before some animals were discovered, as in Hawaii, for example.

The island of Guam is very isolated in the waters of the Pacific Ocean and measures nearly 30 miles long and 4–8 miles wide. A rainfall of about 90 inches per annum is usual and mostly during July–November. The northern half of the island is an elevated limestone plateau originally covered with tropical jungle, of which much still remains. Areas with sufficient soil are occupied by gardens and small farms, and there are a few small settlements. The southern half of the island includes a low volcanic range of mountains near the western shore, the highest peak being 1,334 ft. Streams on the eastern slope are the larger, and at the mouths of the valleys are located coastal villages. Much of the farming is carried on in the valleys, especially rice culture. On the plateau region are some cattle ranches. Rice is the only irrigated crop : not enough is grown to supply all needs and in 1936 importations were made from Japan. Other crops are corn, copra and many kinds of fruits and vegetables.

The foregoing remarks are mainly taken from an account entitled "Insects of Guam I.", which forms Bulletin 172 of the Bernice P. Bishop Museum, Honolulu (1942). This account is made up of some twenty-seven articles by specialists on different groups of insects, and presents the results of studies made on material collected during an entomological survey of the island in 1936. The survey was conducted under the auspices of the Hawaiian Sugar Planters' Association for the purpose of studying insects of economic importance in Guam. This island is the most important station between the Philippines and Honolulu on the route of Pan-Pacific Airways. Unknown insects were already being found in planes arriving in the Hawaiian Islands, and notwithstanding precautions by fumigation of aircraft, an occasional insect was found which had not fully succumbed. There is concern lest unknown pests, injurious to sugar cane or other Hawaiian crops, might gain an entry and become established in the archipelago. It is noteworthy in this connexion that about fifty species of pests of cultivated plants are known in Guam which are not known in Hawaii. The Sugar Planters' Association has always adopted a broad-minded and scientific policy, and it recognizes that among these insects of Guam are no doubt many that would become pests should they reach the Hawaiian Islands and become established therein. Furthermore, the insect fauna of the island is very inadequately known.

Among the various groups of insects dealt with in this bulletin no discrimination is made of those of economic importance—all come in for discussion and description of their species where necessary. It is noted that eleven species of dragonflies and twenty-two species of Thysanoptera but only three species of Aphididæ and a single species of Aleurodidæ are recorded. Butterflies number fourteen species, which is in contrast to the whole Hawaiian Archipelago, which only supports ten species. The Guam butterflies are mostly immigrants, possibly some of recent arrival, as only three or four species had been previously recorded. The most notable are the 'Monarch' *Danaida plexippus* and *Hypolimnas bolina*, the latter being widely distributed in countries and islands in and bordering the Pacific Ocean. Moths are not included in this volume except the Sphingidæ, which number five species, including the cosmopolitan *Herse convolvuli*. Of the Coleoptera the Curculionidæ, with forty-nine species, head the list ; among them no fewer than thirty-three species and eight genera are described as being new. Among Hymenoptera twenty-nine species of ants and ten species of wasps are enumerated. Of the ants nine of the species have been already recorded from the Hawaiian Islands. Only a few Diptera are included in this volume : they comprise, among others, five species of mosquitoes, including the notorious *Aedes ægypti*. A second volume of the survey, dealing with other groups of insects, is promised at a later date when these studies have been completed.

FORTHCOMING EVENTS

(*Meeting marked with an asterisk * is open to the public*)

Saturday, July 10

Institute of Physics (Industrial Radiology Group) (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 2.30 p.m.—Open Discussion on Industrial Radiology.

Sunday, July 11

Association of Scientific Workers (at Birkbeck College, London, E.C.4), at 7 p.m.—Meeting to discuss British Science in the Allied War Effort and to exchange greetings with Soviet men of science meeting in Moscow. Speakers: Prof. J. D. Bernal, F.R.S., J. G. Crowther, Prof. S. A. Sarkisov, and Sir Alfred Webb-Johnson.*

Monday, July 12

Association of Austrian Engineers, Chemists and Scientific Workers in Great Britain (at the Institution of Structural Engineers, 11 Upper Belgrave Street, S.W.1.), at 7.15 p.m.—M. Frantisek Nemec, Minister of Industry and Commerce and of Economic Reconstruction to the Czechoslovak Government: "Economical and Technical Reconstruction in Central Europe".

Tuesday, July 13

Quekett Microscopical Club (at the Medical Society of London, 11 Chandos Street, Cavendish Square, London, W.1), at 7.30 p.m.—Dr. J. R. Baker: "The History of Microscopical Staining Technique".

Thursday, July 15

Royal Society (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Sir Edward Mellanby, K.C.B., F.R.S.: "Nutrition in Relation to Bone-growth and the Nervous System" (Croonian Lecture).

Friday, July 16

Physical Society (at the Royal Institution, Albemarle Street, London, W.1), at 5 p.m.—Brigadier Basil F. J. Schonland, O.B.E., F.R.S.: "Thunderstorms and Their Electrical Effects" (Charles Chree Address).

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Assistant Lecturer in Education and in the Training Department of University College, Cardiff, with special qualifications in science, preferably physics and chemistry—The Registrar (July 16).

Lecturer in Physics at the Polytechnic, Regent Street, London, W.1—The Director of Education at the Polytechnic, stamped addressed foolscap envelope for application form (July 19).

Lecturer in Ferrous Metallurgy at the Chesterfield Technical College—The Clerk to the Governors (July 23).

Assistant Secretary—The Secretary, Institution of Gas Engineers, 1 Grosvenor Place, London, S.W.1 (July 26).

The Johnston Chair of Biochemistry in the University of Liverpool—The Registrar (July 31).

Demonstrator in Anatomy (male or female) in the University of Sheffield—The Registrar (August 2).

Assistant Works Manager, Metal and Steel Factory (Government of India)—The Ministry of Labour and National Service, Central (Technical and Scientific) Register (Reference ON.F.607), Alexandra House, Kingsway, London, W.C.2.

Chief Metallurgist for ferrous and non-ferrous work at Metal and Steel Factory, Ishapore (Government of India)—The Ministry of Labour and National Service, Central (Technical and Scientific) Register (Reference ON.F.1002), Alexandra House, Kingsway, London, W.C.2.

Secretary of the Institution of Professional Civil Servants—The Honorary Secretary of the Institution, 17 Hans Place, London, S.W.1.

Lecturer in Physics and Pure and Applied Mathematics at the Neath Mining and Technical Institute, Glamorgan.—The Principal.

Teacher of Mathematics and Science in the Junior Technical School, North-East Essex Technical College and School of Art, Colchester—The Clerk to the Governors.

Lecturer in Horticulture at Bishop Otter College (Women Teachers' Training College) at the Old Palace, Bromley, Kent—The Principal.

REPORTS and other PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Burton-on-Trent Natural History and Archaeological Society. Local Records for 1942. Presented by H. J. Wain. Pp. 27. (Burton-on-Trent: Natural History and Archaeological Society. The Museum.) 1*s*. [36

Empire Cotton Growing Corporation. Report of the Administrative Council of the Corporation, submitted to the Twenty-second Annual General Meeting on June 1st, 1943. Pp. ii+16. (London: Empire Cotton Growing Corporation.) [36

Institution of Electrical Engineers. The Organization of Post-War Electrical Research. Pp. ii+6. (London: Institution of Electrical Engineers.) [36

Institute of Physics. The Education and Training of Physicis Pp. 8. (Reading: Institute of Physics, The University.) [

Scientific Proceedings of the Royal Dublin Society. Vol. 23 (N.S No. 11: On an Epidemic of *Gibberella saubinetii* (Mont.) Sacc. Wheat in Eire in 1942. By Dr. Robert McKay. Pp. 111–129+plat 4–5. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams a Norgate, Ltd.). 3*s*. [

Association of Special Libraries and Information Bureaux. Repc of Proceedings of the Seventeenth Conference held at the Roy Society, London, November 7th and 8th, 1942. Pp. 72. (Londo Association of Special Libraries and Information Bureaux.) 3 to non-Members, 6*s*. [

Institute of Welding. The Production of Single Spot Welds in Mi Steel Plates of ⅛", ¼" and ⅜" Thickness. By J. Dearden and Dr. Hu O'Neill. Pp. 16. (London: Institute of Welding.) 2*s*. [

Annual Report of the Zoological Society of Scotland for the Ye ending 31st March, 1943. Pp. 22. (Edinburgh: Zoological Socie of Scotland.) [

Institution of Gas Engineers. Communication No. 257: 80 Annual Report and Accounts for the Year 1942. Pp. 32. Communic tion No. 258: Presidential Address. By E. V. Evans. Pp. 32. Co munication No. 259: The Gas Industry—Considerations on Furth Development. Pp. 66. (London: Institution of Gas Engineers.) [

Forestry Commission. Post-War Forest Policy. Report by H. Forestry Commissioners. (Cmd. 6447.) Pp. 114. (London: H. Stationery Office.) 2*s*. net. [1

Ministry of Fuel and Power: Committee on the Efficient Use Fuel. Fuel Efficiency Bulletin No. 18: The Sensible Use of Late Heat, Part 1. Pp. 12. (London: Ministry of Fuel and Power.) [1

Labour Conditions in Ceylon, Mauritius and Malaya. Report Major G. St. J. Orde Browne. (Cmd. 6423.) Pp. 114. (London: H. Stationery Office.) 2*s*. net. [17

The Organization of Post-War Electrical Research. Pp. ii+ (London: Institution of Electrical Engineers.) [2

Other Countries

Proceedings of the United States National Museum. Vol. 93, N 3165: New Genera and Species of Bark Beetles of the Subfami Micracinae (Scolytidae, Coleoptera). By M. W. Blackman. Pp. 34 366+plates 29–30. (Washington, D.C.: Government Printi Office.) [

Indian Central Cotton Committee: Technological Laborato Technological Bulletin, Series A, No. 55: Technological Reports Trade Varieties of Indian Cottons, 1942. By Dr. Nazir Ahmad. P vi+106. 1.8 rupees. Technological Bulletin, Series A, No. 56: Techr logical Reports on Standard Indian Cottons, 1942. By Dr. Na Ahmad. Pp. iv+106. 1.8 rupees. (Bombay: Indian Central Cott Committee.) [1

University of Pennsylvania. Hall Effect and Conductivity Cuprous Oxide. A Dissertation in Physics presented to the Facu of the Grade School in partial fulfilment of the requirements for t Degree of Doctor of Philosophy. By Stephen James Angello. Pp. (Philadelphia: University of Pennsylvania.) [1

Indian Forest Bulletin No. 114: A Note on the Treatment Green *Hollong* (*Dipterocarpus macrocarpus*) Sleepers. By D. Narayan murti. Pp. iii+12+3 plates. 4 annas; 6*d*. Indian Forest Bulle No. 115: How to Distinguish between the Sapwood and Heartwo of *Sal* (*Shorea robusta*). By Dr. K. Ahmad Chowdhury. Pp. iii+3- plates. 4 annas; 6*d*. (Dehra Dun: Forest Research Institute.) [1

Indian Forest Leaflet No. 33: Detailed Design of Timber R Trusses made with Wooden Disc Dowel Joints. By V. D. Lima Pp. ii+13+2 plates. 4 annas; 6*d*. Indian Forest Leaflet No. 3 Types of Timber Seasoning Kilns suitable for Drying Indian Woo By M. A. Rehman. (I. F. Leaflet No. 11, revised.) Pp. iii+7- plate. 4 annas; 6*d*. (Dehra Dun: Forest Research Institute.) [1

Indian Forest Bulletin No. 113: Interim Report on the relati between Rate of Growth and Strength of Natural and Plantati Teak. By V. D. Limaye. Pp. 14. (Delhi: Manager of Publication 7 annas; 8*d*. [1

Indian Forest Records (New Series). Silviculture, Vol. 4A, No. Standard and Commercial Volume Tables for Teak (*Tectona grand* Linn. F.) in the Central Provinces. By Bakhshi Sant Ram. I v+145–170+3 plates. (Delhi: Manager of Publications.) 2.4 rupee 3*s*. 9*d*. [1

Annual Report of the Imperial Council of Agricultural Resear 1941–42. Pp. v+130. (Delhi: Manager of Publications.) 4.10 rupee 7*s*. 3*d*. [1

Fouad I University: Faculty of Science. Special Report, 19 Pp. 129. (Cairo: Fouad I University.) [1

Occasional Papers of the California Academy of Sciences. N 20: Early Naturalists in the Far West. By Roland H. Alden a John D. Ifft. Pp. iv+59. (San Francisco: California Academy Sciences.) 1 dollar. [2

Transactions of the American Philosophical Society. New Seri Vol. 32, Part 3: Research on Early Man in Burma. By Hellmut Terra and Hallam L. Movius, Jr. With Supplementary Reports up the Pleistocene Vertebrates and Mollusks of the Region, by Edw H. Colbert and J. Bequaert; and Pleistocene Geology and Early M in Java, by Hellmut de Terra. Pp. vi+265–464+35 plates. (Phi delphia: American Philosophical Society.) 3 dollars. [2

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Sotheran's Price Current of Literature, No. 871: Annotated Ca logue of Works on Exact Science. Pp. 88. (London: Henry Sother Ltd.)

Photography as an Aid to Scientific Work. Seventh edition. I 16. (Ilford: Ilford, Ltd.)

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THE ATLANTIC CHARTER AND ITS AGRICULTURAL IMPLICATIONS

WHEN the Atlantic Charter was announced, it was widely acclaimed as embodying the great ideals at which administrators all over the world should aim. There was indeed no novelty in the ideals themselves; they had been put forward many times before. The new feature was their acceptance by politicians as not only desirable but also practicable, and therefore to be incorporated in their political programmes. The first step was to call a conference of representatives of the Allied Nations to discuss appropriate action, and this was done by the United States Government. The conference met at Hot Springs, Virginia, during May 18–June 3, 1943; no less than forty-four countries participated. In order to keep the discussion within bounds and to ensure so far as possible a practical outcome, the Conference restricted itself to the consideration of "the goal of freedom from want in relation to food and agriculture", to quote its own words; "freedom from want," it stated, "means a secure, adequate, and suitable supply of food for every man". The results of the deliberations have recently been published as a White Paper.

The numerous technical points that arose are dealt with elsewhere (p. 68); it is proposed here to discuss some of the broader issues. The basic recommendation sounds self-evident but actually involves the most far-reaching consequences; it was that "the Governments and authorities represented should declare to their own people and to one another their intention to secure more and better food for the people", and this was embodied in a resolution which epitomizes the whole of the deliberations of the Conference; each Government bound itself to provide for its own people the highest standard of nutrition which it could achieve, and each undertook to collaborate with the others "so that levels of food consumption may become more equitable, not only among the different sections of the population in a given country but among the several nations of the world as well". It was recognized that food policy and agricultural policy are inseparably intertwined, and during the discussions it became evident that the types of food most generally required to improve the peoples' diets and health are in many cases those produced by methods of farming best calculated to maintain the productivity of the soil and to increase and make more stable the returns to agricultural producers. Better nutrition, in short, means better farming. Seeing that more than two thirds of the human population are producers of food, any improvement in their position must be for the advantage of mankind as a whole.

Next it was shown that there is a close interdependence between the level of employment in the different countries and the standards of nutrition. But the level of employment in turn depends on the character and extent of the industrial development, the management of currencies, the direction of national and international investment, and the policy adopted towards foreign trade. While it could not investigate the methods needed to promote expansion of economic activity, the Conference declared that freedom from want could not be fully attained without this expansion, and recommended that the various Governments and authorities should take action, individually and collectively, to achieve it.

So large a proportion of the human race has hitherto been underfed that higher nutrition for all people even in Europe would necessitate a greatly increased output of food, and if Africa and Asia were included an enormous increase would be required. But the Conference remained undaunted and was convinced that the necessary supplies could be produced. Machinery, however, would have to be set up for dealing with the gluts of food periodically accumulating in bounteous seasons, which have hitherto proved very detrimental to farmers and consumers alike, and of advantage only to certain financial operators. To deal with this it was proposed that 'buffer stocks' should be set up to absorb the excesses of good years and deal them out to places where more food is needed. Finally, it was agreed that matters should not be allowed to rest with the mere publication of these resolutions; a permanent organization should be set up to help in carrying them out, and the task of establishing this body and of attaining the other objectives set forth in the resolutions was assigned to an interim commission composed of one representative of each country, which should meet not later than July 15, 1943. The United States Government accepted the responsibility for calling together this body.

If these proposals are acted upon by the participating nations, a profound change will be produced not only in agriculture but also in world politics. Hitherto three different policies have been adopted in regard to food production. During the *laisser-faire* period of the nineteenth century, the purpose was to give the greatest amount of profit to the individual, but to leave things entirely in his hands, the Government neither deliberately helping nor deliberately hindering him. It was expected that each country would produce the commodities it could most easily and cheaply supply, and the different countries would then exchange their surpluses. This led to specialization, which had many advantages; but in the end the resulting 'mono-culture', as it became termed, proved fatal to the soil; it led to the 'dust bowl' of western North America, and to soil deterioration and soil erosion in many other countries; according to the *laisser-faire* policy, the present owner of the land was entitled to ruin it if it suited him, and no responsibility to the future need be entertained. Quite apart from the bad ethics, there was much bad economics in the system, for when the market requirements changed or a cheaper producer appeared, the cultivators might be ruined before they could find new products and effect the necessary changes in their agriculture, which is always a slow business. This policy has therefore been given up.

Another policy widely adopted was self-sufficiency. Each country should produce all the necessary food that it can, and it should learn to go without those products that could be obtained only from oversea This policy was closely linked up with preparatio for war, either aggressive or defensive. A natio dependent on imports of food, it was argued, woul be in a weak position when war broke out, an indeed the issue might be decided by simply cuttin off its imports. This policy was enthusiasticall adopted by Germany and Italy before the War, an more or less reluctantly by some of the adjacen countries, which felt they had no option but prepare for contingencies.

The third policy is that of optimum nutritio which the Conference adopted. Strictly speaking, has never been tried in all its fullness, but son countries came near to it, notably the United Kin dom, the Dominions, the United States, Denmar Holland, Belgium and Switzerland. For these, con paratively small changes in the type of agricultu would be needed if the high nutrition policy we generally adopted in practice.

The Conference decisions have come as no surpri to agriculturists. A high nutrition policy was pr posed at Geneva in 1934 by Bruce and McDougal Australia, and its implications worked out by O and others; an unofficial group of agriculturis organized by Lord Astor examined its agricultur consequences for Great Britain. It was considere and to a greater or less extent embodied, in each the proposals for the reorganization of British agr culture put forward by the various important r sponsible bodies and by many smaller less-know groups of people. The high nutrition policy nece sitates some degree of planning in agricultur production and this means some degree of control all the responsible bodies are prepared to accept thi It means also something in the nature of a nation contract between farmers on one side and consume on the other, which, of course, implies agreed pric having relation to the costs of production, and pr visions to ensure delivery of the commodities in th agreed quantities and of approved quality; in othe words, power to enforce efficient farming. This als is commonly accepted. The differences between th various sets of proposals are in detail only.

The Royal Agricultural Society, the most widel representative body of all, recommends that a no political statutory body, a Food Commission some what on the lines of the Forestry Commission, shoul be set up in Great Britain to ensure adequate foo production, the maintenance of soil fertility, and price-level sufficient to yield a reasonable profit o average land after payment of adequate wages. Th Government should decide the proportion of th different foodstuffs to be produced at home and i should maintain the price-level by imposing impo duties, not by direct subsidies. Steps would need t be taken for raising the efficiency of farming; ther must be better production, better marketing an distribution, more research, more effort to apply th results of science, and more, and more suitabl education. The National Farmers Union, whic includes a large proportion of the farmers of Grea Britain, proposes the setting up of a Foo Ministry which would regulate supplies and price but as a safety measure there should be maintained in England and Wales a minimum of 11 million acres of tillage land (that is, arable land, *less leys*) including 2¼ million acres of wheat, 600,000 acres of potatoes, 400,000 acres of sugar beet and 800,000 acres of fruit and vegetables; for the ten years prior to the War the actual average figures were: tillage land, 7·1 million acres; wheat, 1·6 million; potatoes, 475,000; sugar beet, 318,000. Price control of wheat and meat should be effected by organizing marketing and imports on the lines recommended by the Sydney Conference of 1938.

The proposals of the Conservative Party also necessitate price stability and satisfactory price-level, effected by controlling the imports of food by an Import Board and a levy subsidy, even in some cases a high tariff. Direct subsidies are to be avoided. Measures for increasing the population and improving the level of nutrition would be welcomed within limits, though a nutrition policy would not obviate the need for general price stability.

The recent memorandum issued by a "Group of Peers holding varying Political Creeds" boldly adopts the nutrition policy, and urges that in our dealings with other countries we should press them also to adopt it. Tariffs afford no solution to the price problem, nor do direct subsidies. They divide agricultural produce into two groups: commodities, the production of which is incidental to good husbandry, such as wheat (oats in Scotland), sugar beet, and meat; and those needed for high nutrition, such as milk, poultry products, fruit and vegetables. For the former it would be essential to set up import quotas at prices agreed beforehand. For wheat, as a safety measure, home production should be approximately the 1939 acreage plus 10 per cent; the price paid would be based on the average cost of efficient production, but the consumer would pay less because he would benefit by the lower price of imported wheat. Any gluts would be cleared by selling at specially low prices to nations below the poverty line. The other products would find a ready market if a nutrition policy were adopted by the nation; at present we do not produce nearly enough of them. For milk, eggs, fruit and vegetables, an increase of 60–70 per cent on pre-war figures would be needed, as well as an additional 25 per cent output of meat.

There is much evidence also that the people of the occupied countries of Europe are ready to accept a high nutrition policy. Certainly they have had a bitter enough experience of the self-sufficiency policy. It was carried out more thoroughly and systematically in Germany than anywhere else, and yet there it gave its people much less of the delectable foods than we had in Great Britain; on the average, only one half our beef and our sugar, very little lamb, only about two thirds of our butter and eggs, and much less fruit. To make up for these deficiencies they had double our rations of potatoes. In other countries things were worse, and a high nutrition policy would be a welcome change. Admittedly it involves difficult economic and administrative problems, but it seems to offer the best hope for reconstruction and for permanent peace. It fully deserves a trial.

AFRICAN GEOMORPHOLOGY

South African Scenery

A Textbook of Geomorphology. By Dr. L. C. King. Pp. xxiv+340+144 plates. (Edinburgh and London: Oliver and Boyd, 1942.) 25*s*. net.

A YEAR ago, C. A. Cotton published a text-book of geomorphology in which the account was illustrated primarily from the topography of New Zealand. A similar volume by Dr. L. C. King, taking its examples from South Africa, has now become available. Whereas New Zealand provides unsurpassed examples of land forms developed in a humid climate, South African scenery has developed under conditions of limited rainfall, often approximating to desert. The new book thus covers a range of phenomena different in detail from those described by Cotton, and the two books are in many ways complementary.

The scope of "South African Scenery" is wider than one might expect. "South Africa" is conveniently taken as the part of the continent south of the equator, so that it is possible to include an account of the East African rift valleys, lakes and volcanoes, and thus extend the description of land forms beyond those available in South Africa proper.

The greater part of the book is devoted to description of the development of land forms by the various erosive agencies, and to their modification by earth movement and volcanic action. This is treated on stereotyped lines, but gains greatly in interest from the constant reference to excellent examples, mainly in southern Africa, and from the freshness of the examples chosen. The land forms are linked with the geological history and surface geology throughout, with a resulting great gain in understanding of the development of the scenery.

An account of the disastrous effect of ravine formation and resulting soil erosion, and of the methods of prevention, is of particular interest in view of the growing importance of the subject. The enactment of new legislation by the Government of Kenya has just been announced, for example.

King makes frequent reference to the effects of Pre-Karroo, Cretaceous and Tertiary periods of erosion, and their separation and identification is a feature which helps to make South Africa unique to geomorphologists. One is, however, inclined to feel that some account might also have been given of the dating of South African river terraces and climatic fluctuations by means of human cultures and the contained fauna, now that information of this kind is becoming available. For example, it would have been more illuminating to have stated that the Victoria Falls have retreated five miles up-stream since the Middle Pleistocene, rather than since man first appeared in the region, and a summary of the evidence bearing upon the date of Pleistocene earth movements would be a welcome addition.

One of the more interesting subjects on which King touches is the uplift of the southern and central parts of the African continent. In East Africa this uplift amounted to 3,000–5,000 ft. over vast areas, and there is evidence to show that it has taken place over a period covering most of Tertiary times. It was largely completed by the end of the Pliocene. The associated rifting movements, however, form a complicating factor and hinder full analysis. In South Africa the rifts are absent, but a comparable uplift has nevertheless taken place. Du Toit

(*S. African Geog. J.*, 16, 3 ; 1933) has given a detailed account of the history of this uplift, which has raised the "Great Miocene Peneplain" to 4,000–5,000 ft. in the High Veld, and King reproduces much of the most recent information on the subject.

When the Miocene peneplain was formed, the surface of South and East Africa must have been nearly at sea-level, and in isostatic equilibrium for a long period. In East Africa the uplifted peneplain is still in isostatic equilibrium, and fossiliferous Miocene beds remain to prove that the surface has not been lowered appreciably by erosion since the middle Tertiary. In South Africa, du Toit suggested that the uplift was due to "unloading under erosion", but King states that the Miocene peneplain is clearly identifiable in the High Veld, and there is in any event no obvious reason for the adjustment having been so greatly overdone. Thus four thousand feet of vertical uplift has affected a third of a continent, without any important folding or thickening of the crust. What changes in the subcrust have produced this remarkable effect ?

A general description of the Rift Valleys and the theories of their origin follows the detailed discussion of effects of the more common types of earth movement. Here King disposes of the rather surprising suggestion advanced a few years ago that the rift valleys owe their formation largely to erosion, and goes on to describe the conflicting tectonic theories of their origin. The 1938–40 eruptions of volcanoes of the western rift in the Belgian Congo are illustrated by an excellent series of photographs, which demonstrate vividly the surface features of recent lava flows.

The latter part of the book consists of a description of the topography of Southern Africa on a regional basis. This section deals first with Central and South-Central Africa, describing the geological history of each country in so far as it affects the physical features, and then goes on to describe the surface features of South Africa *sensu stricto* by natural regions. A considerable proportion of the information in this section is derived from work of the last twenty years, and the description is particularly valuable. This part of the book might perhaps have been improved by extension of the natural region treatment to the whole area instead of using political boundaries for Central Africa, which involves division of the description of the western Rift Valley, for example, between Uganda and the Belgian Congo.

The volume has the disadvantage common among books of this kind in that the only references given are suggestions for further study, and no mention is made of the sources of information or authors of hypotheses. These would be especially welcome in view of the recent character of much of the work on which description is based. One regrets, for example, the omission of any reference to Wayland when the results of his work in Uganda are described at some length in the text. Similarly, although Bailey Willis's monograph on East African geomorphology is quoted in the short bibliography, no reference is given to show where his work is reproduced.

"South African Scenery" is excellently produced and written. The richness of illustration may be indicated by the statement that the book has 144 half-tone plates to 340 pages of text. No one will read this volume without realizing that southern Africa is not merely a country of monotonous peneplain but also has areas of extreme grandeur. The book is a really worth-while possession.

P. E. KENT.

POPULATION AND EMIGRATION

The Political Economy of Population

By Prof. Radhakamal Mukerjee. (Lucknow University Studies, Faculty of Arts.) Pp. xiv+467 (London, Bombay, New York and Toronto : Longmans, Green and Co., Ltd., n.d.) 7*s.* 6*d.*

THE author is the personification of energy and versatility as he pours out book after book devoted to the setting forth of the facts, and inferences, of human ecology. For us, in Europe, he has the added value that he knows a great deal about us and writes in our language, a rather American English, while at the same time speaking from the point of view of a member of the huge concentration of half mankind on the relatively small space of the Monsoon Lands. Mukerjee continually reiterates that political economy, biology, genetics, politics and sociology all fall short because they look at selected elements and neglect others which are vital for the understanding of a composite social process that, in his view, may claim success if it maintains a balance of activities and population that can go on indefinitely. The solution of the population problem in Europe lies neither in the sacrifice of children to the pursuit of a highly artificial standard nor in the sacrifice of personal values to the prestige of the State ; he seeks, rather, a balance. Perhaps he is not explicit enough concerning the mentality apt to spread when decline of population is imminent ; we Europeans know its difficulties only too well from the case of France, 1923–1940.

This book touches briefly a great many, too many, topics, and thereby illustrates our difficulty in scientific study if we try to diminish the undoubted evils of highly selective specialization, but it has many thoughts worth pondering. The author wonders whether high net reproductive rates may not be associated with food rich in vitamin E ; this is, perhaps, one factor but, so far, it would seem wise to moderate such claims. Like other writers, Mukerjee emphasizes the change from the mid-nineteenth century when the vast spaces of western North America seemed to offer limitless opportunities, to the present day when the misuse of some of those opportunities has brought such disastrous results, and he is concerned to show that the more thoughtful members of our populations must be encouraged to accept the responsibilities of parenthood.

The movement of people from the crowded monsoonal lands of Asia and its diminution since the economic catastrophe of 1929–32, with a partial revival for a short time in 1934–35, leads him to discuss the man-made barriers to immigration into the empty lands, and the relatively low birth-rates among important sections of the populations of North America, Australia and New Zealand. He thinks Asiatic peoples might spread a rice-economy in Central America, northern South America, the Guinea coasts of Africa, the south of the Congo basin and elsewhere, and that the East Indies could gain from large-scale immigration. Probably the peoples of European origin who have now spread beyond Europe and North America amount to 10 per cent of Europe's population. Asiatics outside Asia are not only a far smaller proportion of their home populations but also are actually much less than half the number of the Europeans who have spread beyond their two continents, and he pleads for "The Open Door". It is a serious plea and not an easy one either to refute or to accept.

H. J. FLEURE.

AMERICAN ARMY NATURALISTS

Ornithologists of the United States Army Medical Corps

Thirty-six Biographies. By Colonel Edgar Erskine Hume. (Publications of the Institute of the History of Medicine, the Johns Hopkins University, First Series: Monographs, Vol. 1.) Pp. xxv+583. (Baltimore, Md.: The Johns Hopkins Press, 1942.) 5 dollars.

IN this volume Colonel Hume has collected a great deal of interesting biographical information on thirty-six members of the United States Army Medical Corps, who at one time or another were connected with the study of birds. A few of the names are well known outside the United States, such as Charles Bendire, author of "Life Histories of American Birds", Robert Shufeldt, a great student of bird anatomy and contributor to Newton's "Dictionary of Birds", and Eliot Coues, a prolific writer and best known by his outstanding book "Key to North American Birds". The majority, however, are only known to students of works on North American birds, since much of their work was done during the Pacific railroad surveys, and different boundary commissions.

It was, indeed, fortunate that the Government appointed Prof. Spencer Baird, assistant-secretary to the Smithsonian Institution, as naturalist to the railroad survey, since he guided and encouraged the young medical officers who were attached to the different working parties in collecting and observing birds.

One ornithologist claimed by the Army appears as a surgeon in the Navy. This was J. H. Kidder, who began his career in the Army and later transferred to the Navy. In 1874 he accompanied the Transit of Venus expedition to Kerguelen, where he made extensive collections in all branches of zoology and botany. The results were published by the Government under the title of the "Natural History of Kerguelen". By the members of his profession Kidder is best remembered as the founder of the Naval Museums of Hygiene at Washington. It is difficult to understand how John Xanthus became assistant surgeon, and there is much mystery and romance about his career. It appears he was of a good Hungarian family, went to the United States about 1848 or thereabouts, joined the Army as a dresser, and became an assistant surgeon although he had no medical degree. On leaving the Army he served as consul for a short time in Mexico, and then returned to his native land. He does not seem to have been very reliable, but nevertheless Prof. Baird considered him an accomplished collector.

Apart from Shufeldt and Coues, the outstanding figure among the thirty-six names is Colonel E. A. Mearns, who died in 1916. It is computed that there are in the National Museum some 37,000 specimens of vertebrates collected by Mearns, and his contributions to the herbarium are greater than any other individual. Mearns, however, was no mere collector; he kept copious notes and, when time allowed, worked out his collections himself. His first important post was medical officer and naturalist to the Mexican Boundary Commission, and he also served in the Philippines for several years. When President Theodore Roosevelt went on his hunting trip in Africa, he applied to the National Museum for a collector, and Mearns was recommended as the best field naturalist and collector in the United States. The appointment gave every satisfaction, and many notes on game animals and birds in "African Game Trails" are from the note-books of Mearns.

THE VERTEBRATE RETINA

Vertebrate Photoreceptors

By Prof. Samuel R. Detwiler. (Experimental Biology Monographs.) Pp. viii+184. (New York: The Macmillan Company, 1943.) 4 dollars.

THERE is a fairly widespread belief, at least in Great Britain, that not only the brain but also the eye reaches its highest stage of evolution in man. Comparison of the human eye, with its capacity for colour vision, binocular vision and the resolution of fine detail, with those of the restricted group of mammals usually studied, does lend support to such a view, but if one turns aside to consider the eyes of the non-mammalian vertebrates it immediately becomes untenable. Granit's recent work on the differential sensitivity of the retinas of a selection of the lower vertebrates to different parts of the spectrum has shaken our belief that the perception of hue is the prerogative of the primates, some insects and, possibly, the birds. It seems most likely that an animal, such as the owl, with frontally placed eyes, must have binocular vision in spite of the complete decussation of its optic nerves, and no one who has watched a kestrel hover and then stoop on its prey can doubt that its visual acuity must be far higher than our own. Walls' detailed studies of the eyes of many vertebrates have led him to the conclusion that the eye of any given animal has usually reached that stage of development, or sometimes of regression, best suited to serve the needs of its mode of life, and the human eye does not appear to differ from any other in this respect. Man's superiority is not so much due to his better visual apparatus, as Elliot Smith suggested, as to his greater ability to make use of the information supplied by his eyes.

So far there has been but little interest in the eyes of non-mammalian vertebrates in Great Britain, and it is to be hoped that the appearance of Detwiler's new book on vertebrate visual cells, so soon after that of Walls on the vertebrate eye in general, will help to stimulate interest in a fascinating and much neglected subject.

In this book Detwiler is concerned with the structure, development and physiology of the retina, and particularly of its rods and cones. Much of the subject-matter is based on his own work but, on the whole, he is unusually generous in his appreciation of the contributions, both of observation and theory, of other workers. The exceptionally balanced and objective attitude adopted throughout the greater part of the book does, perhaps, result in a certain lack of liveliness, and it is possible that readers who are less concerned with a rather narrowly specialized subject than the reviewer may find it somewhat difficult to maintain their interest. The chapter on the evolutionary significance of the fovea, the only one in which the author comes out wholeheartedly on one side in a controversy (in this case against the theory propounded by Elliot Smith), is certainly the most entertaining. Sometimes, also, one cannot help feeling that Detwiler has gone too far in his kindly attitude towards some ideas which might be allowed to disappear into a well-deserved obscurity. It is surely no longer necessary, for example, to discuss the possibility that the rods and cones are derived from the cilia lining the optic vesicle, since these are now known to disappear long before there is any sign of the developing visual cells.

The chapter on retinal photopigments is unexpectedly weak. Except for the discussion of Kolmer's droplets and their possible constitution, this chapter is based entirely on the work of Hecht and Wald, and the very important and fundamental work of Lythgoe and his colleagues on visual purple and the products of its bleaching is not so much as mentioned. Even the description of Wald's results is confused, although perhaps Detwiler should not bear the whole blame for this, since there are several discrepancies between Wald's earlier and his later papers which have never been properly cleared up. Attention must also be directed to the statement on p. 122 that "[Wald] showed—that the spectrum of pure rhodopsin (visual purple) corresponds in form and position with the spectral sensitivity of human rod vision computed at the retinal surface". Since no other name is mentioned in this connexion the implication is that Wald was the first to demonstrate this correspondence, yet the figure used on p. 121 to illustrate the point was actually published by Trendelenberg so long ago as 1904.

For the rest, the book is excellent and thoroughly reliable. There is a very clear and concise account of Polyak's investigations of the nervous structure of the retina, which is especially welcome since this worker's results are of the most fundamental importance to our understanding of the nervous physiology of vision and are by no means so widely known as they should be. The illustrations consist largely of photomicrographs, many of them made from the author's own preparations and most of them very good.

KATHARINE TANSLEY.

LANGSTROTH, THE APIARIST

The Life of Langstroth

By Florence Naile. Edited, with a Foreword and an Introduction, by Prof. Everett Franklin Phillips. Pp. 215. (Ithaca, N.Y.: Cornell University Press; London: Oxford University Press, 1942.) 15*s*. 6*d*. net.

BEEKEEPERS have waited a long time for a life of Langstroth, but Miss Naile has now produced a pleasantly written and well-arranged volume, attractively got up, which contains all that has been known about Langstroth and a good deal (especially about his ancestry and early years) which will be new to her readers. Prof. E. F. Phillips, professor of apiculture at Cornell University, has supplied the foreword and introduction, and the volume may be regarded as the official American 'life' of Langstroth.

The book has, however, been published during a great war and in consequence has suffered markedly from undue compression. We hope that if a second edition appears it will include more about Langstroth the man, as distinguished from the beekeeper. We should like to know more about him as a preacher, to see a photograph of him in the midst of his family and to know more about his wife and his children; at present the volume seems lacking in human feeling.

In other respects, too, lack of space seems to have made itself felt. When the controversy about Langstroth's patent was dealt with, the position as regards frames should have been explained, and the omission is the less excusable as Colonel Walker discussed the matter fully in a series of articles in the *British Bee Journal* of June 1, 1922, and reprinted in "Beekeeping New and Old", vol. 1, p. 126. Munn, too, and his hive should have been mentioned, as he was a friend of Dr. Bevan, that medical man whose portrait reminds one irresistibly of Pickwick, and whose "Honey Bee" was the best book about bees in its day (in the English language) and seems to have been the source from which Langstroth obtained his first ideas about systematic beekeeping.

Another point worth noting is that a frame is surrounded by six bee spaces; Langstroth first discovered the one above the frame and, later on, those at its base and ends; those on each side had been hinted at by Thomas Wildman (1768 Edn., p. 53).

On November 29, 1851, the *Gardeners' Chronicle* remarked of the American hives exhibited at the 1851 Exhibition, "North America is as fertile in rubbish as the mother country itself", and we think it is correct to say that Langstroth's service to his own generation was the simplification and partial standardization of the design of hives, which, by making them boxes for containing movable frames, enabled the beekeepers of that day to deal with the larger bee moth which, at that time, was reducing American apiaries to ruin. Later generations are inclined to regard him as the man who made extractors, comb foundation, swarm control and other essentials of modern beekeeping possible.

Langstroth's statement about "a small book, the author of which seemed to doubt the existence of such a thing as a queen bee" (p. 64) was quite correct but scarcely did justice to the first bee book he possessed. Jerome V. C. Smith, the author of "An Essay on the Practicability of Cultivating the Honey Bee in Maritime Towns and Cities", was a doctor of medicine who afterwards became mayor of Boston. The book is not a systematic treatise on the art of beekeeping, but it is extraordinarily suggestive and stimulating, and a comparison with the works of contemporary American authors will, we think, convince the reader that Langstroth was remarkably fortunate in his first bee book.

In conclusion, we venture to hope that Miss Naile will continue her study of Langstroth's life and work. We should like to see two more books on the subject from her. The list of Langstroth's library requires a good deal more emendation, and a booklet which dealt with it could be made very interesting. A study of "Langstroth on the Honey Bee" is also required. Americans should be helped to see how Langstroth showed capacity to discriminate between what was correct and incorrect in previous writers and whence he obtained his knowledge and, more especially, attention should be directed to any statements which appear to be original. The illustrations, too, should be examined. (The references are to the 1879 edition of Langstroth's book.) The picture of bees surrounding the queen which appears on the title-page was suggested by one which appeared on p. 48 of Dionysius Lardner (Museum of Science and Art, vol. 10, 1856); Fig. 65 on Plate XIII is Fig. 1 on Plate II of Dunbar's work and Fig. 55 is Dunbar's Plate IV reversed (The Naturalist's Library, vol. 6, Edinburgh, 1840); Fig. 51 on Plate XVI is Fig. V on Tab. XVII of Swammerdam (edition of 1758), and other examples would, no doubt, reward careful study.

H. M. FRASER.

he Carnivorous Plants

By Dr. Francis Ernest Lloyd. (A New Series of Plant Science Books, Vol. 9.) Pp. xvi+352 (38 plates). (Waltham, Mass.: Chronica Botanica Co.; London: Wm. Dawson and Sons, Ltd., 1942.) 6 dollars.

THIS book is by far the most complete survey of the literature in a special, and naturally delimited, field; but it is also a contribution to knowledge in this field embodying many years of intensive work by a vigorous and original worker. Prof. Lloyd's own interest in carnivorous plants began with his studies of Utricularia, and in this monograph the descriptions of the organization and functioning of the many species in this genus and of the allied structures in the little-known genera Polypompholyx and Biovularia occupy a large proportion of the text. Prof. Lloyd's own contributions on the bladder of Utricularia extended considerably our knowledge of its structure and method of working, particularly as to the presence of the second valve membrane at the mouth, the velum, and its significance in facilitating the water-tight closure of the door necessary for the setting of the trap. When he extended his survey to cover other types of carnivorous flowering plants, besides making by far the most complete survey of the literature yet available, in every possible case he has examined material, living when possible, and in many cases as a result new facts are supplied as to development and structure, and he is able, from his first-hand knowledge of the plants under consideration, to give a critical and well-balanced survey of the work of earlier investigators.

Besides a number of text-figures, thirty-eight plates are included. These reproduce numerous original drawings and photographs. The drawings supply details of structure and development; the photographs usually illustrate habitat and have in many cases suffered in reproduction, in particular by the compression into a very crowded page.

In addition, the volume contains an interesting chapter reviewing the meagre facts available about some filamentous fungi which have either used the characteristics of their growth habit to weave hyphal snares for minute eelworms, or through the mucilaginous nature of their wall or contents immobilize and afterwards destroy various animalculæ.

Guide to the Stars

By Dr. Hector Macpherson. Pp. 137+10 plates. (Edinburgh and London: Thomas Nelson and Sons, Ltd., 1943.) 6s. net.

DR. MACPHERSON'S work has been produced primarily for the amateur astronomer, and its simple and lucid style renders it a very suitable book to place in the hands of the beginner. A brief outline of the universe, including the solar system, the galaxy and external galaxies, provides a useful introduction to the main portion of the work—a description of the constellations and their principal stars which are visible during the different seasons of the year. A number of star maps and also six plates at the end, containing eighteen constellations and stars down to the fifth magnitude, will prove very helpful to those who are anxious to learn the names of the stars. Chapter 9 is devoted to a description of the movements of the bodies in the solar system and contains a number of hints on the observations of the sun, moon and planets. A short account of eclipses, transits, occultations, the zodiacal light and the aurora borealis is given in the last chapter. The novice will find this small work an excellent introduction to the study of astronomy. There are a few slips of minor importance, of which the following may be noticed:

On p. 40 it is stated that the Great Nebula in Andromeda is the nearest of the external galaxies, but Messier 33 is a little nearer. P. 80, line 7 from top. This should read, "A line drawn from Zeta to Eta Ursae Majoris. . . ." P. 123. It is more correct to say that the maximum duration of a solar eclipse is about 7½ minutes, not 7 minutes. In the next paragraph, 111 days should read 11 days. M. D.

The Pocket Planisphere

By Francis Chichester. Pp. 4. (London: George Allen and Unwin, Ltd., 1943.) 2*s*. 6*d*. net.

THIS planisphere measures 5½ in. by 5 in. and can be carried in the pocket without the slightest inconvenience. It shows how the stars appear for each month on any selected day or hour to an observer in lat. 50° N. and also in lat. 35° S. On the rotating disk each month is divided into four portions, the first division being on the first of the month; and seven-day intervals are adopted in all cases except at the end of the months, when the arrangement necessitates intervals of nine or ten days. It is very easy interpolating and setting the planisphere for the selected day and also for the time of the night, intervals of one hour being used. As the space between successive hours is six-tenths of an inch, sufficient accuracy for fractions of an hour can be obtained. The names of the important navigation stars are in capitals and numbers are attached to other stars which the navigator may wish to use, a key to these numbers being printed on the back of the mask which covers the star disk. Directions for using the planisphere are supplied; it will prove a very useful equipment for the air navigator.

M. D.

Brompton Hospital Reports

A Collection of Papers recently published from the Hospital. Vol. 11, 1942. Pp. vi+136. (London: Brompton Hospital, 1943.) 5*s*. net.

VOL. 11 of the Brompton Hospital Reports contains fourteen recent articles published in the medical press by members of the hospital staff.

A. F. Foster-Carter contributes a well-illustrated report on "The Anatomy of the Bronchial Tree". "The Care of the Dying", by Clifford Hoyle, contains a great deal of information on points ignored by the standard works, and deserves a wider distribution than it is likely to receive in this specialized publication.

Physical Chemistry for Students of Biochemistry and Medicine

By Prof. Edward Staunton West. Pp. xiv+368. (New York: The Macmillan Company, 1942.) 28*s*. net.

THIS book is noteworthy for an excellent survey of recent developments in knowledge of atomic and molecular structure. The scope is wider than is suggested by the title, and it goes far beyond the requirements of the average medical student. It can be recommended as a book of reference for workers in biology and physiology.

SCIENCE IN CHUNGKING

By DR. JOSEPH NEEDHAM, F.R.S.

British Council Cultural Scientific Mission in China

THE present article is a continuation of the two recent contributions describing scientific work now going on in Yunnan province (south-west China). It will be followed by contributions on West Szechuan, on Kweichow and Kuangtung provinces (south-east China), and on the far north-west. It is hoped that by this means the mutual isolation of Chinese, British and American scientific workers may be mitigated.

Strictly speaking, Chungking itself is not a scientific centre any more than Westminster. The city, situated in a splendid position on a series of hills between the two great rivers where the Djialing joins the Yangtse, maintains its pride, and temporary houses have sprouted like bamboo-shoots all over the much-bombed areas. It has so often been described that a detailed account here is unnecessary, but the innumerable air-raid shelters blasted in the rock of the hillsides must be mentioned with praise. Life in the city is not so uncomfortable as is sometimes pictured, and always made agreeable by the unfailing good humour and spontaneous charm of the Chinese people themselves.

Among the Governmental organizations concerned with science, the National Resources Commission, presided over by the Economic Minister (himself a geologist), Dr. Wong Wen-hao, assisted by the able Mr. Chien Chang-chao, employs 165,000 workers up and down the country, and 12,000 administrative and technical personnel. Of the latter, more than 80 per cent are less than thirty-five years of age, including about 5,000 university graduates and about 400 technical and scientific experts who have spent many years in the West. The National Resources Commission is opening up natural resources everywhere in Free China, and its functions are to develop, operate and control basic industries, important mining enterprises, important electrical power enterprises, and also to administer other industrial enterprises as assigned by the Government. Like the Department of Scientific and Industrial Research in Britain, it subsidizes research in many universities, as well as research institutes. Then the National Health Administration, situated in a suburb, Bridgetown (place-names are purposely translated and garbled for security reasons), under Dr. Chin Bao-Shan, carries out the same functions as our Ministry of Health, and controls a National Central Medical Research Institute, to which I shall refer later.

In order to visit the important scientific work going on in the neighbourhood of Chungking, it is necessary to go out into the country some two hours motor ride in different directions. At Sandy Hook, for example, some distance up one of the great rivers which meet at Chungking, is to be found the National Central University, formerly at Nanking, but now occupying a site within the campus of the Szechuanese Chungking University. Both these universities push on with the teaching of scientific subjects in the face of rapidly dwindling supplies of essential chemicals and apparatus. In the chemical laboratory of the National Central University work is proceeding, under Prof. Kao Chi-Yu, on the parachor and on the effect of acids, bases and salts on the optical rotation of organic compounds; besides studies on oil paints and lacquer for aeroplane finishing. In the plan physiology and pathology department, Dr. She Chih-I (secretary of the Chinese Natural Scienc Society, an organization somewhat resembling ou Association of Scientific Workers) studies the viru diseases of Chinese crop plants and the peculia water requirements of rice varieties. In the biologic department, Prof. Ouyang Chu pursues the studie on brain histology which he began with Oscar Vog in Germany in former days, much handicapped b the damage which his microtomes suffered during th journey from Nanking. The physicists are als active. Dr. Sze Se-Yuan invents new cuprous oxid rectifiers, and means of making storage batterie locally, while also studying the production of per manent magnets with tungsten steel. Good work i proceeding, too, on the ultra-violet spectrum of th carbon monoxide molecule excited by bombardmen with electrons (Messrs. Chao Kuang-Tseng and Yan Chun-Chung). Nor is mathematical physics neglected Dr. Chang Tsung-Sui (formerly a pupil of Sir Ralp Fowler) is actively working on the theory of th meson, and papers by him have very recently bee communicated to Great Britain through the Britis Scientific Mission in China.

Of the other institutions at Sandy Hook, Chungking University specializes in chemical engineering, in which subject Dr. Peng Shou-Ling (formerly with Sir Alfred Egerton at the Imperial College of Science and Technology, London) takes a prominent place. There is also the National Central Technical College, a Government institution for the training of working mechanical engineers, under Wei Yuen-Kuang as director. Among the laboratories of this College is one for hydraulic engineering and irrigation, reminiscent of what the friends of the Cambridge Geography School are accustomed to refer to irreverently as the 'mud-pie department'. But nothing could be more important for China, and this laboratory is suitably situated in Szechuan, the legendary home of the Great Yü, China's earliest irrigation engineer, who "mastered the waters" at the dawn of history, and worked so hard that "in ten years he passed the door of his house three times yet did not enter in". Finally, the famous Nankai Institute of Economics is also situated at Sandy Hook.

Undoubtedly the greatest scientific centre is a small town, Windbox Gorge, lying on another of the great rivers. Here there are no fewer than eighteen scientific and educational institutions, most of them of great importance.

To begin with, there are two Institutes of Academia Sinica, the Institute of Biology and the Institute of Meteorology. The former, under the leadership of Dr. Wang Chia-Chi, is extraordinarily active, with some twenty scientific workers fully occupied. Dr. Wang himself is a well-known protozoologist, and besides being head of the Institute, he directs the protozoology department. The head of the department of vertebrate systematics is Dr. Wu Hsien-Wen; they are concerned especially with the taxonomy of the fishes, but also study fish ecology and physiology. Thus Chang Hsiao-Wei is studying interesting adaptations to life in mountain torrents (for example, the 'stone-climbing fish'), and Liu Chien-Kang the chloride-secreting cells in the gills of the paradise fish. Dr. Chen Shih-Hsien heads the entomology department; here work is proceeding on insect systematics, physiology (respiration, excretion, stridulation, etc.) and on the control of mosquito arvæ by fishes and the insect-catching plant Utricu-ria (Miss Tan Chuan-Chieh). Dr. Rjao Chin-Chih, he algologist, heads the department of botany, which deals largely with the systematics of the higher lants, notably the Umbelliferæ. A visitor, admiring the situation of the Institute high above the great iver, and viewing the work going on in it, feels that t has the true research atmosphere of the world's est laboratories.

The Institute of Meteorology is rather a charming contrast to that of Biology. It stands on a high hill-top far from the river, looking out over terraced rice-fields on all the slopes, and it needs much fewer workers. Under Dr. Lü Chung (director) and Chen Tze-Cheng, however, it is extremely efficient in massing observations by regular balloon ascents, tc., and has an excellent library.

No less important than these institutes, and on a much larger scale, is the Chinese National Geological Survey. Its present director is Dr. Li Chun-Yü, and is the successor of the internationally known V. K. Ting (who presided over the discovery of Peking Man) he has a distinguished position indeed. The Survey has three Divisions: that of Geology, which includes Palæontology, Mineralogy and Petrology, Geophysics and Seismography, and a Cænozoic Laboratory; that of Cartography; and that of Soil Science. The cartographical work (under Dr. Tseng Shih Ying) is very active, as also is the geophysical ide. Here Dr. Li Shan-Bang has shown the greatest ingenuity in constructing seismographs, a pendulum apparatus for the measurement of g, and accurate clocks, literally with pieces of scrap metal and whatever can be got in Free China's west. He is now held up for photographic registering paper, which the British Scientific Mission (among very many similar efforts) is trying to secure for him. The palæontologists are constantly engaged in working over the very large numbers of specimens which the field expeditions of the Survey are always bringing in. Dr. Yin Tsan-Hsun described, for example, immensely ich triassic finds newly brought from Kweichow province.

The library of the Geological Survey, situated some miles away from the main building, on a hilltop in most beautiful country, is one of the largest and best equipped which I have seen anywhere in Free China.

Two other Government organizations of the first mportance are to be found at Windbox Gorge. One s the National Bureau of Compilation and Trans-ation (under the Minister of Education, Dr. Chen Li-Fu), and the other is the National Institute of Industrial Research. The first of these, presided over by the eminent scholar, Dr. Chen Ko-Chung, conducts an enormous work of standardization. For scientific men, its most important function is the settling of Chinese versions of scientific terms, a matter of great difficulty in view of the wide divergence between Chinese language and thought and that of the West, where modern science originated. Of these standard dictionaries, fifteen have already appeared (dealing with astronomy, mathematics, physics, mineralogy, embryology, and the like), thirty-two more are nearly ready to print, and thirty-three more are still in card index form. The method adopted is interesting. First, all the technical terms are card-indexed, with their various Chinese versions, then a choice is made, and finally the whole is sent out in the form of mimeographed ledgers to all the experts in the subject in question, who indicate their agreement or disagreement. If deadlocks occur, conferences are called. The Bureau employs no fewer than 200 workers, of which 130 are university men, including some very distinguished scholars, ex-presidents of universities. This work by no means exhausts, however, the Bureau's activities. It is also responsible for examining the text-books used in elementary schools, middle schools, etc., for compiling new encyclopædias and dictionaries, for translation of books (both from and into Western languages), for issuing collected editions of the classics, and for producing booklets of popular education for the masses. It is safe to say that no other Government, save perhaps that of the Soviet Union, supports such a wide programme of purposive scholarship. In the view of the Chinese Government, moreover, the Bureau needs enlarging to at least double its present size. Among the books officially translated have been Stebbing's "Modern Introduction to Logic", de Broglie's "Theorie de la Quantification dans la nouvelle Mecanique", Haas's "Einführung in die theoretische Physik", Crowther's "Ions, Electrons, and Ionizing Radiations", Howell's "Textbook of Physiology", Truscott's "Treatise on Ore-Dressing", and Sidney and Beatrice Webb's "Soviet Communism: a New Civilisation".

Imposing also in size is the National Institute of Industrial Research, which has other centres besides the main one at Windbox Gorge. Under the directorship of Dr. Ku Yu-Chuan, it comprises sixteen laboratories (fermentation, oils and fats, pure chemicals, motor fuels, analytical, colloid, cellulose, ceramics, plastics, tanning, machine design, electrical textile, strength of materials, heat power, forest products, sugar, salt and alkali). We can only glance at a few of these. In the fermentation division, Dr. Chin Pei-Sung manages the Chinese National Collection of Type Cultures, and much work is being done on acetone, alcohol and butyl alcohol fermentations. The pure chemicals division (Dr. Li Erh-Kang) produced five tons last year of all kinds of pure acids, alkalis and salts, but this is, of course, not nearly enough for China's research and production needs. In the forest products division, a remarkable effort has been made to recover the wood tar from the innumerable peasant charcoal-kilns all over the province. These have been fitted with bamboo condensers, with the result that many tons of valuable acetone and acetic acid have been made available, thus laying the foundations of an important decentralized wood-tar industry. The peasant coke-ovens are now being dealt with in the same way, which will be even more important. The plastics division has done pioneer work in the use of soya-bean oil-press cake as a basis for plastics, and many articles are now in production from indigenous waste protein and carbohydrate sources. The motor fuel division (Dr. Ku Yu-Djen) is doing fine work in the cracking of vegetable oils and the purifying of the gasoline so obtained. This Institute corresponds, therefore, to all the activities of the Department of Scientific and Industrial Research and the Research Associations of Great Britain rolled into one, but following our former analogy, the National Physical Laboratory and the Fuel and other Research Stations must all be considered as having been transferred, with the loss of most of their equipment and no locally existing facilities, to the shores of Loch Assynt!

The last important Government organization at Windbox Gorge is the National Agricultural Research

Institute, with its divisions of potato husbandry (in which the well-known American geneticist, Dr. Theodore F. Dykstra, is now working with Chinese colleagues), rice husbandry, soil science and plant pathology. In the last-named division, Dr. Chu Feng-Mei has constructed a very ingenious apparatus, almost entirely out of bamboo, for the separation of the round nematode-infested grains of wheat from the healthy elongated ones. In this way the parasites are not perpetuated when the seed is sown.

We come now to three non-Governmental institutions in this same place. First, the Science Society of China has its biological laboratory there in a secluded valley. It is actively engaged, under the veteran Dr. Chien Tsung-Su, on plant and animal systematics. This was the society which for many years published the Chinese equivalent of NATURE and *Science*, *Ko Shioh*. The editor, Lu I-Tao, is now in Chungking, and hopes are entertained of its early revival. Then there is the All-China Institute of Geography, an organization supported by the Sino-British Board of Trustees. Prominent in this Institute are Ling Chao (a former pupil of Prof. P. M. Roxby at Liverpool), who is shortly leaving for an expedition in Sinkiang, and Yang Kai-I (from Edinburgh) is also going as secretary to the head of the scientific survey of that province. Finally, there is Futan University, relatively small in numbers of students, but with a high academic reputation. Its laboratories are mainly devoted to teaching, but in biology Dr. Hsieh Fen is working on the growth-rate of cyprinid fishes.

Something must now be said of the scientific work at another place, Singing Stone Valley, away in the sandstone mountains through which the river cuts its course. Here are located the National Central Hospital, the Shanghai Medical College, and the National Health Administration's Research Institute. This last corresponds closely to the British National Institute for Medical Research at Hampstead, but in subject is more akin to the Wellcome and Lister Institutes. Its buildings are new, with a particularly good auditorium, hidden away among the wooded rocky hills with the ricefields at their foot. Among the various divisions under the directorship of Dr. Chu Chang-Kan there are nutrition (Wang Cheng-Fa), sanitary chemistry and engineering, medical entomology (Ho Chi), parasitology (Yuan I-Chin), pharmacology and bacteriology (Mrs. Wang Rjo-Yü) Excellent work is going on in all these.

The Shanghai Medical College ranks very high as a medical school, with the famous Peking Union Medical College, Hsiang-Ya (Yale-in-China) Medical School, and the medical colleges at Chengtu. The able administration of the pharmacologist and expert in Chinese drugs, Dr. Chu Heng-Bi, stands for an exceptionally thorough grounding in the fundamental sciences underlying medicine, and for the provision of opportunities for scientific post-graduate work. In the present rural surroundings and with so little equipment, this last requirement can scarcely be adhered to, but the staff of chemists and physiologists is exceptionally good, and the student level as high as anything so far seen in China. Thus the biochemists, Chi Yueh-Feng and Rjen Bang-Chih, were pupils respectively of Profs. Treat B. Johnson (purines) and H. B. Lewis (sulphur metabolism) in the United States. Among the students here are many from the now exiled Hongkong University Medical School, and they have one of their professors, the obstetric surgeon, Gordon King, on the staff at Singing Stone Valley.

In conclusion, the persistence and success of Chinese institutions with so little help and facilities again clearly appears. British science and Government alike should spare no pains to send help to those who are, among the United Nations, in science's 'front line'.

NON-SOLAR PLANETS

By DR. A. HUNTER

THE possibility that other stars besides our sun may possess planetary systems is one that has been the subject of speculation for centuries. Double stars in plenty are known, of course, and the orbital separations of the components are often of planetary order. In these cases, if the system is fairly close to the sun, the component stars are easily separable in big telescopes, and their angular separation can be measured directly with a micrometer. But the immensity of cosmic distances ensures that all stellar companions which can be detected directly in this way are of stellar brightness. No planet reflecting as little light (relatively speaking) as, say, Jupiter could be seen or photographed from our solar system even if it accompanied our nearest stellar neighbour.

This is not to say, however, that we are precluded from discovering planetary systems attached to other stars. There is the possibility, for example, that the gravitational effect of a planet can be detected from careful observations of the position of its primary. From such observations bodies of stellar mass have already been discovered: perhaps the most famous case is that of the faint companion of Sirius, the existence of which was deduced from the perturbed motion of its primary more than ten years before it was detected telescopically. The difference between this case and that of perturbation by a planet is evidently one of degree and not of kind. Only recently, however, have observations of the requisite accuracy become available. These are the photographic observations made at many observatories all over the world for the purpose of determining stellar distances.

The principle employed is that of parallactic displacement, as used in ordinary surveying, the base-line used being the diameter of the earth's orbit. Careful measurements of the apparent direction of a star on one night and of its direction six months later are combined with our knowledge of the size of the earth's orbit to give the distance of the star. In practice, the observations are delicate, for even the closest star has a parallax of less than a second of arc. The work must be spread over many years if small observational errors are to be reduced to a minimum, and in order to eliminate systematic errors of period one year, which would obviously vitiate the results, the measurements are made differentially, that is, the parallactic displacement of the star is measured not absolutely but with reference to faint distant stars in the background. In practice, the observation consists in securing up to half a dozen photographs at each of five or more epochs of maximum parallactic displacement. The photographs are then measured and the results analysed by introducing three unknowns—namely, a constant, the proper motion and the parallax—and solving by least squares.

But if the apparent motion of the star is not merely a parallactic displacement superposed on a rectilinear proper motion, in particular if the star and an invisible companion are revolving around their common centre of mass, this procedure is not adequate. If it is in fact carried out (as it will be, in a routine observation, since we shall have no *a priori* knowledge of the presence of a companion), the residuals found from the measurements at the various epochs will show a systematic trend. The discovery of periodicities in certain parallax residuals was announced some years ago, but as has been recently pointed out[1], spurious periods of about two years are obtainable from almost all parallax measurements. They are indeed to be expected from general considerations: the method of reduction will tend to balance a large accidental residual at any epoch by residuals of the opposite sign a year earlier and a year later. Some recent work on two frequently observed stars, however, is based on accurate data extending back over some decades, and points very strongly to the presence of companions the mass of which is so small that they would be more accurately described as planets than as stars. It so happens that both these stars are visual binaries, so that the newly discovered companions make them into triple systems.

The system 61 Cygni consists of two sixth-magnitude stars making in 720 years a complete revolution in a large orbit with a semi-major axis of 25 seconds of arc. Extensive photographic observations of high accuracy, made over nearly thirty years, now reveal[2] small deviations from Keplerian motion which can only be explained by assuming that a third invisible component of small mass revolves around one of the main components. If the measurements are reduced on the assumption that the system consists of only two components, residuals are obtained which show a well-marked periodicity both in Right Ascension and in Declination, the period being 4·9 years and the amplitudes about 0·01″. The measurements are made only on the *relative* positions of the visual components A and B, so there is no way of knowing to which of them the perturbing member C is attached. However, the masses of A and B obtained from their known luminosities are practically identical, so that whichever is used in conjunction with the dynamical elements of the small orbit, the same result is obtained: the mass of C is only 0·016 times that of the sun, and the semi-major axis of its orbit is only 2·4 astronomical units (that is, 2·4 times that of the earth). The orbit is so eccentric that at periastron this invisible planet must come within 0·7 astronomical units of its primary. Allowance for the perturbation introduced by the third body removes the systematic trend of the residuals and halves their mean value. We have thus strong evidence for the existence in the 61 Cygni system of a body of mass only about sixteen times that of Jupiter. This is little more than one tenth that of the lightest known star (Krüger 60B, mass 0·14 sun), and the claim that the new companion should be regarded as a planet rather than as a star is evidently very weighty.

The other binary system in which a component of planetary mass has just been discovered[3] is 70 Ophiuchi. This consists of two stars of magnitudes 4·3 and 6·0 revolving in a relative orbit of period eighty-eight years and semi-major axis rather less than 5″. Careful study of photographs taken over a period of nearly thirty years shows periodic deviations from this binary orbit, the observations suggesting a secondary period of seventeen years and amplitudes of about 0·015″ in both X and Y co-ordinates. Again it is impossible to know to which of the main components the perturbing body is attached, but this time A and B are of rather different mass. If the planet revolves around A (mass 1·1 sun) the orbital radius will be 6·8 astronomical units and the mass of the invisible component 0·012 sun. If it is attached to B (0·7 sun) the radius of its orbit will be 5·9 astronomical units and its own mass only 0·008 sun. Here again, then, we have a third body, in what had hitherto been regarded as a binary system, with a mass of about one hundredth that of either of the visual components. In this case the claim of the newly discovered body to be regarded as a planet is even stronger: its mass is only about ten times that of Jupiter.

The state of astronomy is now such that by extending the programme of parallax observations somewhat, invisible planetary companions not much more massive than Jupiter could be discovered if they are in fact attached to the nearer stars. If systematic observations for this purpose were instituted by international co-operation after the War, it could be decided within a relatively short time whether planetary systems are or are not a rare cosmic phenomenon. A definitive answer to this long-standing query would obviously have an important bearing on theories of the origin of our own solar system.

[1] Jackson, J., *Mon. Not. Roy. Ast. Soc.*, **102**, 257 (1942).

[2] Strand, K. Aa, *Pub. Ast. Soc. Pacif.*, **55**, 29 (Feb. 1943). See also NATURE, **151**, 283 (1943).

[3] Reuyl, D., and Holmberg, E., *Astrophys. J.*, **97**, 41 (Jan. 1943).

UNITED NATIONS CONFERENCE ON FOOD AND AGRICULTURE

A BRIEF summary of the report and a list of attending delegates and of resolutions passed at the United Nations Conference on Food and Agriculture held at Hot Springs, Virginia, during May 18–June 3 has been published by H.M. Stationery Office*. The Conference was attended by delegations from forty-four countries. The British delegation of nine was under the chairmanship of Mr. Richard Law, Under-Secretary of State for Foreign Affairs.

"The Conference met to consider the goal of freedom from want in relation to food and agriculture. In its resolutions and its reports, the Conference has recognized that freedom from want means a secure, adequate and suitable supply of food for every man."

Freedom from want, the Conference declared, means more than freedom from hunger, but the attainment of the latter is a first essential step towards the attainment of the greater, ultimate good. The Conference recognized that to free the entire population of the world from hunger or malnutrition would require a greatly increased production of foodstuffs, but saw no insuperable technical obstacles to achieving the required level of production. Assuming that such obstacles as have existed in the past could and would be overcome by the technical ingenuity of man, the Conference proceeded to consider the less tractable problems of social and political organizations, on the solution of which the realization of universal freedom from want ultimately depends.

The results of the deliberations are contained in a series of thirty-odd resolutions, the text of which

* Final Act of the United Nations Conference on Food and Agriculture. Cmd. 6451. (London: H.M. Stationery Office, 1943.) 9*d*. net.

comprises the main part of the publication. A full report of the Conference has, apparently, been prepared, and reference is made to it, but it has not yet been published.

The first resolution is in the form of a declaration that the first task of the United Nations, after winning the War, will be to free the peoples of the world from hunger. The full attainment of this goal must be a long process, but essential thereto are greatly increased food production and economic regimes which ensure to all sufficient purchasing power to buy their necessary food. The responsibility that the people have enough food for health and well-being lies with the several nations, but each nation can fully attain the goal only if all work together. The resolutions of the Conference were framed to suggest the kind of machinery that might be set up to promote international collaboration in this vitally important field, and the kind of tasks with which the machinery will have to deal and to which it must be adapted.

The most important resolution of the Conference is that which recommends the setting up of a permanent international organization to promote such measures of food production and agriculture as will raise the levels of nutrition and standards of living of the peoples of the world. Recognizing the urgency of making a start, the Conference recommends the immediate setting up in Washington of an interim commission on which each of the participating Governments was invited to designate a representative before July 15, 1943. The interim commission would automatically dissolve when the permanent commission was established.

The main purpose of the interim commission would be to draw up and submit for the consideration of the participating Governments plans for the form and functions of the permanent organization. It would also formulate a declaration embodying the obligations of each nation to collaborate in the improvement of agriculture and in raising the standard of nutrition. Each Government would be invited to subscribe to this declaration.

The two paragraphs outlining the proposed scope and functions of the permanent organization are important enough to be quoted in full:

> "That in the preparation of a plan for the permanent organization the Interim Commission give full consideration to the following:
>
> (*a*) The relation of the permanent organization to, and methods of associating it with, other institutions, national as well as international, which already exist, or which may hereafter be established, in the field of food and agriculture and in related scientific, economic and other fields;
>
> (*b*) Provision for membership in the permanent organization, in due course, of governments not represented on the Interim Commission;
>
> "That in considering the functions and duties to be assigned to the permanent organization the Interim Commission take into account:
>
> (*a*) The promotion of scientific, technological, social and economic research;
>
> (*b*) The collection and dissemination of information and provision for the exchange of services;
>
> (*c*) The submission to member governments and authorities of recommendations for action with regard to the following:
>
> (i) Nutrition;
> (ii) Standards of consumption of food and other agricultural products;
> (iii) Agricultural production, distribution and conservation;
> (iv) Statistics and economic studies in the field of agriculture and food, including the study of the relation of agriculture to world economy;
> (v) Education and extension work in the field of food and agriculture;
> (vi) Agricultural credit;
> (vii) Problems of agricultural population and farm labor."

A further extension of the functions of the permanent organization into the fields of commodity control, agricultural co-operative movements and land tenure is also tentatively proposed.

It is this permanent organization, to be devised by the interim commission, which will give effect to, or provide the machinery whereby the several Governments can jointly give effect to, the resolutions of the Conference and other measures afterwards designed to bring the ultimate goal of the Conference nearer attainment.

The Conference further recommends that the several Governments should formally declare their intentions immediately to take measures to increase the food resources and to improve the diets of their peoples in accordance with the principles and objectives outlined at the Conference.

The fourth resolution recommends that Governments should undertake positive measures to improve the diets of 'vulnerable' social groups, namely pregnant and nursing women, children and large families in low-income groups.

Resolution V recommends that, whereas a diet at a level merely sufficient to prevent malnutrition is not enough to promote health and well-being, Governments should actively encourage the study of health in relation to nutrition and the dissemination of knowledge of correct feeding. Resolution VI refers to the prevalence of certain deficiency diseases and the need for taking measures to eliminate them and to prevent their recurrence.

Assuming that measures are taken to improve diets and to eliminate deficiency diseases, the Conference recommends (Resolution VII) that national nutrition organizations be established to ascertain the food-consumption habits and nutritional status of different sections of the population, with authority to make recommendations in the light of their findings. Resolution VIII recommends that these organizations periodically and freely exchange information and experience among themselves, and report the results of their investigations to the permanent commission; and Resolution X that the work and experience of organizations already existing for similar purposes should be fully used, whenever possible.

Resolution IX recommends that the goal of food policy in each country should be the optimal diet in quantity and quality, and that Governments should distinguish clearly between this goal and the more immediate goal of minimal diets, at which in many cases they will first have to aim.

Resolution XI recommends that the permanent commission considers questions relating to the production of certain non-food marine and agricultural products, especially those on which some countries ill-adapted to produce their own food depend as a main source of income.

Resolution XII recommends that, as a first step in overcoming the general shortage of food, every effort should be made by countries the agriculture of which can be expanded in the short-term period to increase the acreage under crops for direct human consumption, and even to hold back the rebuilding of depleted livestock herds as well as the production of other crops which compete for acreage with essential foods. This recommendation is made to both those countries where agriculture has, and those where agriculture has not, been impaired by the War. The Conference recognized that the first and most vital task for all will be to eliminate the post-war hunger that will ravage so much of the world. In order to make the best use of the inadequate supplies of food, fertilizers, agricultural machinery, etc., that will be available for some years after the War, it is further recommended (Resolution XIII) that the several Governments affirm the principle of mutual responsibility for the increased production of essential foodstuffs to the utmost capacity of each country, the effective distribution of such foodstuffs, the prevention of speculation in food and other necessities under the anticipated conditions of scarcity, and the gradual adjustment of national agricultures to secure balanced expansion of production and consumption throughout the world.

Resolutions XIV and XV deal with the change-over from a short-term to a long-term agricultural policy. As a working basis the Conference recommends that national farming systems should be adapted to the natural and economic factors of the environment, and should be designed so as to maintain soil fertility and provide steady employment throughout the year. In general, this implies the adoption of mixed rotational farming. The evolution of such systems must be paralleled by the development of programmes of education and research and the provision, where needed, of technical assistance and adequate credit to the producers.

Resolution XVI makes specific recommendations for ensuring an adequate supply of credit to agriculture, and Resolution XVII stresses the importance of establishing farmer co-operative societies in all countries. Resolution XVIII recommends that surveys be made of existing systems of land texture. Resolution XIX enlarges on the importance of providing agriculture with efficient educational, research and technical services.

Resolution XX refers to soil erosion as "the greatest physical danger to the world's food production", and recommends that each nation undertakes the necessary economic and other measures to conserve its soil and water resources, while the permanent commission formulates the principles of soil conservation and facilitates the interchange between nations of conservation experts. Resolution XXI deals with the development and settlement of unproductive lands by drainage, irrigation, soil amelioration, etc. The permanent commission would perform a co-ordinating and controlling function similar to that envisaged in Resolution XX.

Resolution XXII recommends the development of subsidiary industries, internationally controlled emigration, and financial assistance in the intensification of agriculture in regions suffering from rural over-population.

Resolution XXIII recommends in the interest of international security the removal of barriers to the expansion of international trade.

Resolution XXIV makes suggestions for achieving an economy of abundance that read rather like an election manifesto. Resolution XXV recommends that the broad principles be formulated upon which international commodity arrangements should be based in order that such arrangements will contribute to the well-being of the peoples of the world, and proposes that an international organization be created for this purpose and to co-ordinate the operation of such arrangements in accordance with the principles agreed upon.

Resolutions XXVI and XXVII recommend special national and international measures for wider food production, special attention being given to the feeding of "vulnerable" groups and the making available of protective foods to all.

Resolution XXVIII recommends that the permanent commission investigates the practicability, and fosters the adoption, of international grade standards for agricultural and marine commodities with a view to a general improvement in the marketing and quality of food products. A wide extension of market research is advocated, and the taking of steps by the Governments concerned to protect both the producer and the consumer of food against the practices of those who regard them as legitimate prey.

Resolution XXIX recommends that the permanent commission studies the technical, scientific and economic problems of food processing, storage and distribution, and that steps be taken by each country to make full use of new technological processes developed since the War. Resolution XXX urges that the margins between the price to the producer and cost to the consumer be reduced by whatever means are practicable.

Resolution XXXI urges that the conclusions reached by the Conference regarding agricultural produce apply, whenever appropriate, to fish and marine products also, and that these subjects be considered equally by the permanent commission.

OBITUARIES

Prof. Antonín Šimek

FROM a reference in the *Chemisches Zentralblatt* to a notice by Prof. F. M. Jaeger in the *Chem. Weekblad* (August 22, 1943; 39, 454), it is learned that Dr. Antonín Šimek, professor of physical chemistry at the Masaryk University of Brno, Czechoslovakia, must have died about a year ago.

Šimek, who was one of the foremost Czechoslovak physical chemists, was born at Nové Hrady in Bohemia in 1887, and studied at Prague and in Holland, where he made many life-long friends. With the establishment of the Czechoslovak Republic in 1918, he was called to the newly-founded Masaryk University and for many years was fully occupied with the equipment of his laboratories and in academic work, though he found time to conduct researches on tellurium and its oxides. During this work he observed a curious phenomenon that still remains unexplained. He fused tellurium dioxide on electrically heated platinum foil and noticed that the molten drops always move away from the negative pole and towards the positive one. The substance would even travel uphill and its velocity was proportional to the current. In attempting to repeat the experiment with selenium dioxide, which had to be heated under pressure, Šimek met with a serious accident.

Besides being a physical chemist of distinction, Šimek was also a keen mineralogist and he examined a number of Moravian minerals for their content of the rarer elements. Mention has been made of Šimek's connexions with Holland. He also made several visits to England and used English text-books with his students. For their benefit, too, he translated A. S. Russell's "Introduction to the Study of Radioactive Substances" (1925) and Bragg's "Concerning the Nature of Things", and he made a feature of lecturing upon contemporary work in science. Most of his work was published in Czech, but he also wrote in Dutch and occasionally in English journals.

In 1926 he married his assistant, Miss Hannah

Kadlcová, who shared not only his scientific interests but also his devout Protestantism, and both were interested in the Czechoslovak Student Christian Movement.

Šimek, who died at the early age of fifty-five, will be sadly missed when Czechoslovakia is again liberated and the Masaryk University of Brno is re-opened. G. DRUCE.

WE regret to announce the following deaths:

Dr. Mary Jane Rathbun, honorary associate in zoology since 1915 of the U.S. National Museum, known for her work on the Crustacea, particularly the crabs, recent and fossil, on April 4, aged eighty-two.

Mr. H. L. Sikes, C.B.E., formerly director of public works, Kenya Colony, on May 23, aged sixty-one.

BRITISH AND RUSSIAN MEN OF SCIENCE

EXCHANGE OF GREETINGS

THE following message from Prof. Lena Stern, of the Academy of Sciences of the U.S.S.R., to British men of science was transmitted by the Embassy in London of the U.S.S.R. to the Royal Society. With the view of carrying out its intention, Sir Henry Dale, president of the Royal Society, has asked us to publish the message, so that it may reach a wide constituency of those for whom it is intended, together with the reply which he has forwarded to Prof. Stern through the Soviet Embassy.

Message from Prof. Lena Stern

On the day of the second anniversary of the War, I would like to tell you a little of how we Soviet scientists are carrying on to-day, working for our common cause of victory.

In this historic struggle of two worlds, of two world outlooks, of two diametric principles—good against evil, light against darkness, civilization against barbarity—our science has wholly devoted itself to freeing culture from the menace of Hitlerism, to defending the freedom of all nations.

Without exception, all our scientific workers—young and old, men and women—consider it their sacred duty to give all their strength and energy, all their knowledge and their very lives for this cause; and they fulfil their duty sublimely, disregarding all difficulties and all privations which the War has brought in its wake.

The work which is being carried on so intensively at our factories and mills, in our research institutes, in our university departments and in our war hospitals is wholly directed towards helping the front, to perfecting the arms of war, to protecting the health of our fighters. Our science is closely bound up with all the manifestations of the life of the people, both at the front and behind the lines, so much so that it is impossible to divide the man of learning from the fighter, just as it is impossible to divide the research institute from the factory.

It can be said without exaggeration that the heart of the whole people beats in unison with the front and that the slogan "Everything for the front" is not mere words but an actively motivated feeling of the entire people, of our multi-national State.

It is gratifying to be able to state that the theoretical achievements of our science now find wide and successful utilization in the defence of our country and in the strengthening of the fighting powers of our army. Personally I, with my pupils and associates, have since the first days of the War bent all our strength and knowledge to solving problems of the successful treatment of wounded fighters. I am happy beyond words that the results of our many years of theoretical researches now find application in the treatment of such dangerous complications attending injuries as those of shock and tetanus, as well as in accelerating the healing of wounds and the combating of fatigue.

One feels the greatest satisfaction at knowing that by our work to-day we are bringing nearer the hour of our common victory, bringing nearer the advent of peace under which creative work will be able to develop to its full force.

We must all remember that our peaceful, constructive endeavours, the labour of free men of science, can be ensured only by complete victory over the enemy. I believe this victory will come as the result of the joint offensive by the Allied Armies.

Warmest greetings to you, my friends.

Moscow, June 27. LENA STERN.

Reply by Sir Henry Dale, G.B.E., F.R.S.

The receipt of your message to British men of science has given great joy, and reminded me of my friendship with you, and our work together for international science, before the enemies of mankind inflicted on the world its present miseries, by their ruthless attack on the freedom and civilization of independent peoples.

Your stirring message came to me as president of the Royal Society of London, and, on behalf of all British men of science, I most heartily reciprocate your greetings and encouragement. We send to all the scientific workers of the U.S.S.R. an assurance of our full union with them, and with the men of science of all the great alliance, in a strong and fierce determination to use the utmost measure of our knowledge, skill and devotion to ensure and hasten the utter defeat of the enemies of freedom. We are equally determined that, with that defeat, conditions shall be established beyond danger of further attack, in which the scientific men of all nations may work for the greater happiness and health of all mankind.

Tell our comrades, the scientific workers of the U.S.S.R., that we, the scientific workers of Britain and of all the British Commonwealth, have been wholeheartedly devoted to these aims and these ideals during nearly four years of war, and with continued enthusiasm and growing confidence during these two years, in which we have known that our colleagues of the U.S.S.R. were our open and devoted allies in this tremendous war for freedom. We watch with unbounded admiration the achievements of the armies, workers and men of science of the U.S.S.R. for the common cause. We rejoice to know that we are marching together for the freedom of science and of the world.

With my friendliest personal greetings to yourself, and from all British men of science to all those of the U.S.S.R. HENRY DALE (President).

Royal Society, July 7.

NEWS AND VIEWS

Department of Scientific and Industrial Research: New Director of Food Investigation

DR. CHARLES S. HANES, who has recently been appointed director of food investigation in the Department of Scientific and Industrial Research, was born in Canada in 1903 and graduated at Toronto. He entered Downing College, Cambridge, in 1925 as a Junior 1851 Scholar and was awarded a Senior Scholarship in 1929. He obtained the Cambridge Ph.D. degree in 1931. He was a research fellow of the Ontario Research Foundation during 1931–35, in which year he joined the staff of the Department of Scientific and Industrial Research at the Low Temperature Research Station, Cambridge. In 1942 he was elected a fellow of the Royal Society.

Hanes's first published paper was on resin formation in seedling conifers (*J. Linn. Soc.*, 1927), and his subsequent papers have dealt with various phases of carbohydrate metabolism, more especially the action of the enzymes involved in carbohydrate breakdown and synthesis. The culminating point of his researches (to date) was the "Enzymic Synthesis of Starch from Glucose-1-Phosphate" (NATURE, **145**, 348; 1940). Hanes thus achieved the production of starch from sugar as a laboratory process. In collaboration with W. T. Astbury and F. C. Bell, Hanes showed that synthetic starch was indistinguishable by X-ray analysis from natural starch (NATURE, **149**, 558; 1940) In 1941 Hanes was sent by the Department of Scientific and Industrial Research to Canada and the United States with the object of facilitating the exchange of scientific and technical information relating to the preservation of foodstuffs. Later he was lent to the Ministry of Food for service with the British Food Mission in Washington. On the formation of the Advisory Committee on Dehydration of the Combined Food Board, Hanes became its chairman.

Johnston Chair of Biochemistry at Liverpool: Retirement of Prof. H. J. Channon

PROF. H. J. CHANNON, who is leaving the Johnston chair of biochemistry in the University of Liverpool at the end of the present academic year to take up an appointment with Unilever Ltd., is a recognized authority on fats and fat metabolism. After graduating in both arts and science from University College, London, he worked in the biochemical department there, either alone or with various colleagues, on the biological significance of the unsaponifiable matter of various liver oils, on cholesterol metabolism and on the nature of the lipoid constituents of cabbage leaves. This latter research led to the isolation of two new interesting compounds, diglyceride-phosphoric acid and dimyristyl ketone. Throughout this period he displayed a marked keenness for teaching as well as for research, and on being called to succeed Prof. Ramsden at Liverpool in 1930 he was able to give full vent to both these urges.

Giving at first a priority to teaching, Channon reorganized the biochemistry courses for the medical students and particularly for those taking the B.Sc. degree in the subject; his efforts here have undoubtedly borne fruit, and until the inevitable interruption by the War, a steady stream of well-trained graduates came from his department to find employment in academic research or in industry. Many collaborated with him in his own researches, which dealt *inter alia* with the fate of injested hydrocarbons, the desaturation theory of fatty acid metabolism and the effects of various factors in the production of dietary fatty livers. A clear and convincing speaker in lecture or discussion, Prof. Channon's transfer to industry will leave a gap in academic circles that will be hard to fill. He leaves, nevertheless, with a wide experience of research on fats and related substances which should enable him to make the fullest use of opportunities that lie ahead, and his former colleagues will wish him all success in his new venture.

Future of the British Colonial Empire

AN important statement on the future of the British Colonial Empire was made in the House of Commons on July 13 by Colonel Oliver Stanley, Secretary of State for the Colonies. Colonel Stanley said that the foundations of political responsibility in the Colonies must be based on the twin pillars of educational advance and economic development. The Colonial universities would have an important part to play in advancing higher education; they would have to produce leaders, and also do an increasing amount of research. The universities of Great Britain can help in this development, and the institution of a kind of lend-lease intellectual service between them and the universities of the Colonies would result in many advantages to both parties. A commission of inquiry under the chairmanship of Sir Cyril Asquith is being set up to consider how this co-operation can be best achieved. Another commission, under Mr. Walter Elliot, will consider higher education in British West Africa; African representatives of the areas involved have been invited to serve on this commission.

Dealing with the more general topics of economic development and administration, Colonel Stanley said the work of labour advisory boards has enabled the two sides of industry to meet and has encouraged the principle of collective bargaining. Some three hundred trade unions are now in existence in the Colonies. It is hoped to open a course, extending over two years, at the London School of Economics, on training for leadership in societies, and open to people from the Colonies, and particularly Africans and West Indians. So far as development is concerned, Colonel Stanley said that a special department is being created in the Colonial Office to deal with communications, and special interest is being taken in air transport. Industrial development will, he believes, depend upon private enterprise, under proper control.

In replying to the debate, Colonel Stanley added an important note on Colonial administration. He said that while the Government is convinced that such administration must continue to be the sole responsibility of Great Britain, it is desired to work in close and friendly co-operation with neighbouring and friendly nations. To this end, the Government is considering the possibility of establishing commissions for certain regions, these commissions to consist of representatives of States with Colonial territories in the region and of other States with major economic or strategic interest therein. Each State would remain responsible for the administration of its own territory, but such commissions would provide permanent machinery for collaboration in promoting the welfare of Colonial territories generally. Colonial peoples would be associated with the work of the commissions. The formation of such commissions would be a great step forward in promoting the international recognition of trusteeship, as opposed to ownership, of Colonial territories.

Aspects of Demobilization

THE important address of Sir William Jowitt to representatives of municipal and business interests of Merseyside, delivered in Liverpool on June 17, directed attention to a vital but complex aspect of post-war reconstruction. The complexity of the problems of demobilization should be apparent to all, but Sir William Jowitt's remarks on the subject were reassuring in that he said that the fatal mistakes of 1918–19 will not be repeated. Sir William urged that it would be foolish to involve members of the Fighting Forces in any controversy about rival schemes of demobilization ; past experience justifies the reminder that it would be highly dangerous. The very difficulty of devising a fair and efficient scheme of demobilizing in the shortest possible time a huge number of men and women and resettling them in peace-time work in industries, most of which would be short of raw materials, while many of the factories would require re-tooling and re-arranging, makes it imperative that a policy should be decided upon promptly and that it should be explained intelligently as soon as possible to prevent misunderstanding later on. Sir William Jowitt stated that the Government has adopted a scheme in which the guiding factors are age and length of service. Clearly, however, demobilization cannot be based entirely on these principles. The necessity for armies of occupation, apart from the probability of the war with Japan continuing after Germany has been defeated, will involve a partial demobilization, and the release of men may have to be determined to some extent on transport grounds, for example. Similar considerations may apply to industry. A more orderly transition from war to peace than in 1918 means that some workers will be more urgently required than others when peace-time industry is starting up and the process of re-equipment and reconstruction commences.

The *Economist* has indicated some broad principles of industrial demobilization that merit consideration. Capacity capable of working directly for export should be freed from war obligations as soon as possible. Food, clothing and shelter should come before luxuries. Industries capable of being reconverted to peace work without expensive re-equipment and re-tooling should be allowed to turn over as soon as practicable, to economize the resources needed for immediate reconstruction. British demobilization, both of machines and men, should be an integrated part, not only of the continuing war effort of the United Nations, but also of the joint plans made by them for relief and reconstruction on a world scale. The service of such principles leaves no room for pointless argument, but equally it demands of the Government prompt decisions which must be made known and fully explained. In demobilization—and indeed in reconstruction generally—the channels of assent can never be dug too deep if acrimony is to be avoided.

Association of Teachers in Technical Institutions

AT the annual conference of the Association of Teachers in Technical Institutions, held in London during Whitsuntide, Mr. J. C. Hazelip of the Leeds College of Commerce was inducted as president of the Association. It is some fifteen years since a teacher of commerce was elected to the office. In his presidential address Mr. Hazelip referred to the additional work undertaken by technical colleges during the War. It includes training of R.A.F. and Royal Navy personnel in radio work and of the R.A.O.C. and the R.E.M.E. for the many maintenance jobs which a mechanical army needs in the field. There is also the training of members of the A.T.S for clerical and other work. Mr. Hazelip stressed the importance of this contribution by the technical colleges to the national war effort "since success in modern warfare is largely a matter of being in possession of the necessary equipment and of the technical skill to keep it in working order". Thus, he said, the work of technical education is an important factor in bringing the present struggle to a successful issue. He stressed, too, the fact that this additional work had gone on "without interference with normal technical college activities". With the possibilities of an Education Bill in mind Mr. Hazelip sketched arguments against merging junior technical and commercial schools into a "multilateral school". Technical education, he said, must be conducted in an atmosphere of realism and must be able to call upon the services of men and women who themselves had experienced the difficulties and problems "inherent in the spheres for which the students are being prepared educationally". Technical education must be dovetailed into the industrial and commercial life of the community round it. This realistic atmosphere, he said, could not be found in the normal secondary school. He insisted, however, that notwithstanding the realism of its approach, the junior technical school in its work in English subjects, science and foreign languages, would stand comparison with any similar work now being carried on in any other type of post-primary school.

War Background Studies

No. 7 of the series of Smithsonian Institution War Background Studies, by J. F. Embree, is devoted to an account of the Japanese nation, its origins and present social structure. The reader is assumed to have some familiarity with Japanese art and literature, costume and types of building. The economic framework of the lives of the people is only very briefly touched upon, and nothing is said about the physical geography or climatic conditions of the country. On the other hand, nearly half of the 36 pages are devoted to the family and household structure and to the customs surrounding the events of the individual life from birth to death, and there is a short chapter on religious beliefs. The author is of the opinion that the obvious differences between the mental processes of adult Japanese and Americans are solely the result of these customs, outlook, and beliefs. Perhaps the most helpful and charming feature of this brochure is its sixteen excellent photographic plates.

No. 8 of these Smithsonian pamphlets, by H. G. Deignan, gives an account of Siam and its inhabitants. In this case a description of the geographical setting is given, and the whole work might be considered as an introduction, but little more, to what would indeed prove a very interesting study. The region dealt with can be divided into a northern, an eastern and a central area, the latter passing down southwards into the Malay peninsula to the frontier of the Straits Settlements. The aboriginal Negrito popula-ion can to-day only be found in isolated groups in he hills: at least three migrations from the north aving at various times overrun the land. It was ut a few centuries ago that a number of petty ingdoms arose, and only comparatively recently hat what can be called a real national feeling has eveloped. Siam is a country little known to the verage white man. It merits somewhat more etailed treatment than has been possible in these 8 pages. The illustrations, once again, are delightful.

Work of the Tennessee Valley Authority

THE article "T.V.A. An Achievement of Democratic Planning", by Dr. Julian Huxley, which occupies the greater part of the June number of *The Architectural Review,* should be of wide interest in view of the absence in Britain of adequate descriptions of the work of the Tennessee Valley Authority. This concise but comprehensive account of T.V.A. in all its implications, which is illustrated by many photographs, most of them new, gives a striking demonstration of the possibilities of judiciously and democratically applied regional planning. The article is timely, for in the post-war planning which must be undertaken in Great Britain we cannot afford to neglect the experience gained in ten years work on the world's boldest venture in regional reconstruction. Moreover, Dr. Huxley includes a critical examination of the limiting conditions of such democratic planning and stresses the essential characteristics: the making of the greatest number of decisions on the spot; development so far as possible of the active participation of the people themselves; co-ordination in the field of the work of all the other agencies concerned; and decentralization of the idea behind an administration so that its planning becomes a part of public opinion. The provision of full powers for a limited function with the organization developed, and the special methods of survey and system of research deliberately adjusted to consumer needs, are all new tools, as Dr. Huxley points out, which will be of service to any democracy in its struggle to control its own social destiny.

Scientific workers will be particularly interested in Dr. Huxley's concise account of research carried out by the Tennessee Valley Authority. In its chemical laboratories a method has been worked out for extracting aluminium from certain common types of clay, which has reached the pilot plant stage, and work on the extraction of magnesium from olivine is also coming to the pilot stage. In the biological field, valuable research has been carried out on malaria control, the incidence of malaria and the encouragement of fish life. The most important aspect of its agricultural research is concerned with the prevention of erosion, including the growing of new cover-crops, while the investigation devoted to the perfecting of agricultural machinery is an excellent example of research carried out and applied from the point of view of consumer interests. This has led, for example, to an electric hay-drier, costing less than 10 per cent of the previous cheapest drier on the market, and a cheap furrow seeder. Elaborate experiments have been conducted to discover suitable trees and shrubs which will yield crops of fruit or nuts suitable for direct human consumption or available for pigs or other animal stock. Much research has been put into the development of a new type of pressure-cooker for producing cotton-seed meal and oil. Other research has led to the development of quick-freezing machinery suitable for use by farmers' co-operatives, which has much increased the growing of various fruit crops. The planned surveys of the Authority are of equal interest, and a new type of land classification has been worked out with the co-operation of the National Resources Planning Board; and a land-use survey has also been prepared for the most important areas of the Tennessee Valley.

Aid for Chinese University Students

THE International Student Service Committee in Chungking is a constituent member of the National Student Relief Committee, which works in close co-operation with the Chinese Government and enjoys the full support of the United Aid to China Fund in Great Britain. Among other schemes, the National Student Relief Committee has organized a system of national scholarships, under which two hundred select students receive free maintenance, university education and constant tuition. The International Student Service Committee in Chungking has made itself specially responsible for the creation of a student centre at Shapingba, near Chungking, for refugee students from the occupied zones, and from all parts of Free China. A large percentage of them is homeless and penniless; others receive small grants for food, books, clothes and university fees. A well-stocked library is maintained for them; discussion groups are run on many subjects, including economics, diplomacy and current international topics.

The International Student Service in Great Britain (11D, Regent Street, London, S.W.1) has during past years sent out regular appeals in aid of the universities of China. It has been able to send out more than £1,000 annually, and hopes to be able to continue this assistance. Any amount collected is now being passed on to the United Aid to China Fund, which has promised to transfer the donations and to make recommendations to Madame Chiang Kai Chek, in whose hands lies the allocation of funds in China. Further information concerning its activities in this connexion can be obtained from the Secretary of the Service, at the above address.

Protection from X-rays and Radium

THE revised edition of the recommendations of the British X-Ray and Radium Protection Committee (32 Welbeck Street, London, W.1) embodies no drastic changes from the previous issue of this report. Certain precautions have been made more precise, and data relating to more powerful X-ray apparatus and larger quantities of radium used as mass units have been included. Thanks to these recommendations, the extension of irradiation methods into industrial practice should not be followed by an increase in the band of X-ray martyrs who suffered during the early years of the introduction of these methods into medicine. Attention is directed in the report to special Defence Regulations relating to the precautions to be observed by all those engaged in painting objects with radioactive fluorescent mixtures. Although reference is made to the desirability of systematic blood-tests and the measurement of the concentration of radon in expired air, it is strange that no recommendation is made for the periodical inspection of the hands of persons habitually engaged in the manipulation of radioactive preparations or containers. Another apparent omission is the neglect to direct attention to the dangers attending the surgical use of diathermy apparatus in the presence of ether vapour. The thanks of all workers in the field of radiology throughout the world are due to the British X-Ray and Radium Protection Committee for its pioneer and continuing labours in this field.

Vitamin C Content of Oranges

IN the issue of the *New England Journal of Medicine* of January 7, Dr. Arthur D. Holmes, James A. Patch and Francis Tripp of the Research Laboratories of E. L. Patch Co., Stoneham, Mass., record their observations on the relation of season, weight and price to the vitamin C content of oranges. They found that there was considerable seasonal influence on nutritive value, the oranges being heavier and containing more juice at a lower vitamin C cost in December than at any other seasons of the year. The cost of 75 mgm. was 4·8 cents in March, 5·9 cents in June and September and 3·6 cents in December. The average purchaser, therefore, cannot use the size or cost of oranges as a reliable guide to the amount of juice or to the cost of the daily requirements of vitamin C.

New Zealand Earthquakes

DURING March 1943, fifteen strong earthquakes were registered by the seismographs at Auckland, Arapuni, Bunnythorpe, Christchurch, Kaimata, New Plymouth, Tuai and Wellington, all stations participating in the New Zealand Seismological Service and sending records or readings to the Dominion Observatory at Wellington (New Zealand Seismological Report—Provisional Bulletin, No. *P* 133, 1943, March). The records are remarkable in that eight of the shocks had a depth of focus greater than normal. The first, on March 4, had an epicentre south of Fiji and a depth of focus near 600 km. The shock of March 11 with epicentre east of New Caledonia had a depth of focus near 100 km. Earthquakes on March 15 and 21 have already been reported in NATURE, the data coming from the U.S. Coast and Geodetic Survey. On March 26 a very strong earthquake with an epicentre south-east of Tonga had a focal depth of between 80 and 100 km. It was reported to have been felt at Nukualofs, according to a message from Apia. The earthquake gave very large amplitudes on the vertical components of seismographs. Further, there was minor seismic activity, and 22 earthquakes or earth tremors were reported as having been felt (additionally) in New Zealand. The greatest of these shocks was Scale VI on the Modified Mercalli Scale. It occurred on March 14 and was felt in the southern part of South Island. Two earthquakes were felt with Scale V intensity. The first, on March 1, was felt from Te Kuiti and Waipawa to Greymouth and Rakaia. The second, on March 25, was felt at Westport. One shock was felt with Scale IV intensity and the rest with lesser intensities.

Earth Tremors in Portugal

EARTH tremors accompanied by earthquake noises were reported from Oporto, Braga and Viana do Costelo in north Portugal to have taken place on the night of June 22. Although these tremors caused some apprehension, they did not last long and no serious damage has been reported.

Centenary of the S.S. *Great Britain*

ON July 19, 1843, in the presence of the Prin Consort, the famous *Great Britain* was floated in t dock at Bristol in which she had been under co struction for four years. As the first iron ship bu for the Atlantic traffic, as the first ocean-going scre ship, and as by far the largest iron ship built to that time, she stands out as a magnificent specim of the art of shipbuilding as carried out by fa sighted, energetic and unprejudiced men. She w 322 ft. long, 50½ ft. wide and at a draught of 18 had a displacement of 3,618 tons. The credit f her construction belongs to Captain Christoph Claxton, R.N., secretary of the Great Western Stea ship Co., the famous engineer I. K. Brunel, Willia Patterson, a Bristol shipbuilder, and Henry Richa Guppy, another Bristolian who afterwards did go engineering work in Italy. When completed in 184 the *Great Britain*, after being visited by Quee Victoria, took her place beside the *Great Western* o the Atlantic and made several crossings. Unfortu nately, in September 1846 she ran ashore in Du drum Bay, Co. Down, but was salved a year late She was refitted as an auxiliary screw ship, and f many years employed on the Australian run. I 1882 she was converted into a sailing ship. He active service came to an end four years later, whe after a severe buffeting off Cape Horn she put int Port Stanley, Falkland Islands, where she becam a wool hulk. Up to 1938 at least, she was still so used an eloquent testimony to the quality of her iron hul and the workmanship of the Bristol shipbuilders.

National Research Council, Canada : Scholarship

THE National Research Council, Canada, announce the award for the academic year 1943–44 of 14 fellowships of the value of 750 dollars each, 30 studentship of 650 dollars each and 21 bursaries of 250 dollar each. The sixty-five successful candidates for thes post-graduate scholarships comprise graduates o fifteen Canadian universities, and they will carry ou research work in the coming year at eleven of thes institutions. As a result of war conditions, the field of science in which the scholarship holders will wor are reduced in number as compared with a few year ago. By far the greatest number will work in variou branches of chemistry related to the war effort According to a general classification adopted i announcing the awards, 49 will study chemistry 6 physics (including one radiology), 4 biochemistry 2 genetics, and one each biology, mineralogy, mechanical engineering and electrical engineering.

Announcements

THE following have been elected officers an members of council of the Institution of Electrica Engineers for the year 1943–44 : *President :* Sir A Stanley Angwin ; *Vice-Presidents :* Mr. T. G. N Haldane, Dr. E. B. Moullin ; *Hon. Treasurer* Mr. E. S. Byng ; *Ordinary Members of Council* Brigadier F. T. Chapman, Mr. J. Hacking, Mr. A. L. Lunn, Dr. J. L. Miller, Mr. J. S. Forrest, Mr. E. C. S. Megaw, and Mr. E. Leete.

WE have received a copy of the revised pamphlet "Photography as an Aid to Scientific Work" from Ilford Ltd., Ilford, London. This gives lists o plates, films and papers suitable for all branches o scientific work, including medicine and surgery, clinical photography and radiography. There are also notes on filters and darkroom safe-lights.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Factorial Analysis of Physical Growth

The 'Harvard growth study'[1], based on measurements of the same children year after year, is a type of co-operative research which urgently needs repeating in Great Britain. There are, however, one or two conclusions to be drawn from the American data which the investigators themselves seem to have overlooked. Until recently, it has been commonly supposed that there is no general factor entering into physical growth analogous to the general factor entering into mental growth[2], and no convincing evidence for the existence of group-factors, distinguishing human body-types, analogous to the well-established group-factors found in work on temperament, mental imagery, and the like (ref. 1, p. 291 and refs.). That physical development should proceed so differently from mental development would be somewhat surprising; but a glance at the literature shows that statistical methods adopted by Kretschmer, Spearman, and others in studying relations between physical measurements were scarcely as adequate as those now employed to establish mental types and mental factors in the field of individual psychology.

On applying the newer technique of 'multiple factor-analysis' to physical measurements, obtained from groups of English school children and students, I found strong *prima facie* evidence both for a general factor and for type-factors[3]. Similar results have since been obtained with groups of a different racial composition: Dr. J. I. Cohen, at my suggestion, analysed measurements for a Jewish sample, and reported the results in these columns[4]; more recently, Mr. W. H. Hammond has reached the same conclusions with measurements collected from Welsh adults by Prof. H. J. Fleure and from Irish adults by Mr. Mogey[5]. But perhaps the most interesting confirmation of all is to be found in the Harvard data, where correlations are available for a far larger group, comprising more than five hundred 16-year-old American youths (ref. 1, p. 301). On applying the same technique as before, I find, first a general factor accounting for more than 60 per cent of the total variance, and secondly a bipolar factor distinguishing persons showing relatively excessive growth in 'vertical' directions (height, length of leg, arm, or trunk) and those showing relatively excessive 'transverse' or circumferential growth (iliac width, chest width, chest depth, weight). The second factor points to much the same distinction as that drawn by earlier French and Italian physiologists, and popularized by Kretschmer's work on psychotic patients, namely, the distinction between asthenic, leptosomic, or microsplanchnic types and pyknic, eurysomic, and megalosplanchnic types respectively.

The confirmation is the more remarkable because the American investigators themselves regard their measurements as "illustrating the futility of trying to describe any but extreme cases as types". Like so many, however, they interpret 'types' as implying sharply discriminable classes rather than relative or partial tendencies; and they make no attempt to eliminate the obscuring influence of the more powerful 'general factor'. How far the so-called types may be due to racial, genetic, or endocrinological 'factors' is a question which statistical analysis alone is not competent to determine. It may be added, however, that the discovery of factors of two kinds, one influencing size, the other proportion or shape, is fully consistent with the distinction between isogonic and heterogonic growth in lowlier animals[6] and with the theory of two fundamental forms of growth recently put forward by Smalhausen at the Institute of Experimental Biology at Kiev.

University College, London.
June 18.

Cyril Burt.

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[1] Dearborn, W. F., Rothney, J. W. M., and others, "Predicting the Child's Development" (1942).

[2] Spearman, C., "Abilities of Man", p. 141 (1926). Thomson, G., "Factorial Analysis of Human Ability", p. 280 (1939).

[3] Burt, C., *Brit. J. Med. Psych.*, **17**, 184–187 (1938).

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Semi-conducting Properties of Stannous Sulphide

Semi-conducting properties of metallic oxides have received considerable study in recent years and have contributed largely to the theory of defect structures. By comparison, little attention has been paid to the heavy-metal chalcogenides, although their pronounced semi-metallic properties (for example, lustre, very high conductivity) suggest that among them, if anywhere, might be found the intrinsic Wilson semi-conductors[1]. In this connexion, a special interest is attached to such compounds as lead sulphide and stannous sulphide, in which the cations possess unutilized valency electrons, which might well contribute to the metallic conduction. With this in mind we have studied the conducting properties of stannous sulphide, and present here our main conclusions. A fuller account and discussion of the experimental data will be published elsewhere.

In agreement with an isolated measurement by Tubandt[2], stannous sulphide is an electronic conductor at all temperatures. Even at the highest temperature investigated (750° C.), the ionic component of the conductivity certainly does not exceed 1 per cent of the total conductivity. Preliminary observations show that no pronounced increase in conductivity accompanies fusion (melting point of stannous sulphide, 870° C.), so that the liquid is probably a semi-conductor also.

Variation of conductivity with temperature can be represented by a two-term formula

$$\varkappa_{I_s} = Ae^{-E_1/RT} + Be^{-E_2/RT}.$$

The high-temperature conductivity is reproducible from one specimen to another, and independent of past history; $E_1 = 12{,}600$ cal. This presumably corresponds to intrinsic semi-conduction. At lower temperatures (for example, below 300°), impurity conduction supervenes, and the manner in which the number of conducting centres and the activation energy E_2 depend on the previous treatment of each specimen indicates that under these conditions positive hole conduction takes place, in a non-stoichiometric crystal.

This may be exemplified by the accompanying data. Treatment of one particular specimen with pure hydrogen increased R_{18° almost 2,000-fold. Exposure at the ordinary temperature to air, or to hydrogen containing a trace of oxygen, or reaction with hydrogen sulphide, led to a rapid increase of conductivity. This clearly points to the taking up of oxygen or sulphur which, once incorporated in the crystal as oxide or sulphide ions, can be removed only by reduction at temperatures above 300°.

We infer that stannous sulphide is non-stoichiometric, with a range of composition on the sulphur-rich side of the ideal formula. In accord with the variable valency of tin, a certain proportion of tin atoms are raised to a higher valency (on energetic grounds trivalency appears more likely than quadrivalency, although no compounds of trivalent tin exist), and a corresponding number of cation sites are left vacant. Each such positive hole is potentially a conducting centre, which can migrate through the lattice by switches of the excess charge from cation to cation. Assuming a reasonable value for the mobility of an electron in stannous sulphide[3], our figures indicate that 'equilibrium' stannous sulphide, that is, stannous sulphide exposed to oxygen, or heated in hydrogen sulphide to 300°, contains between 1 in 1,000 and 1 in 100,000 excess anions. At ordinary temperatures this confers a conductivity far outweighing the intrinsic conductivity, since the conduction band lies about 0·55 volts above the highest occupied level.

Treatment of Stannous Sulphide	R_{18° ohms	K_{18° mhos	E_s, cal.
Exposed to air. $pO_2 = 152$ mm.	288	$1 \cdot 1 \times 10^{-2}$	3200
Reduced in pure hydrogen at 350°	501,000	$6 \cdot 8 \times 10^{-6}$	8300
Exposed to cylinder hydrogen, $pO_2 = 0 \cdot 76$ mm.	1,100	$2 \cdot 9 \times 10^{-3}$	5100
Exposed to poor vacuum, $pO_2 < 0 \cdot 1$ mm.	13,600	$2 \cdot 4 \times 10^{-4}$	5500
Treated with hydrogen sulphide at 300°	288	$1 \cdot 1 \times 10^{-2}$	3200

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[1] Wilson, *Proc. Roy. Soc.*, A, **133**, 458 (1931); **134**, 277 (1932).

[2] Tubandt and Haedicke, *Z. anorg. allg. Chem.*, **160**, 297 (1927).

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Reaction between Long-Chain Cation-active Salts and Sodium Hexametaphosphate

DURING an investigation involving the use of cation-active salts such as cetyl pyridinium bromide in conjunction with sodium hexametaphosphate, it was observed that precipitates frequently occurred. Further observations on distilled water solutions showed that cation-active long-chain salts of this class give rise to intense turbidity and in some instances to complete precipitation when treated with sodium hexametaphosphate ("Calgon").

The nature of the insoluble complex is not known, but other phosphates such as Na_3PO_4, Na_2HPO_4 and NaH_2PO_4 are without effect. Tetra sodium pyrophosphate gives a slight turbidity.

The literature appears to contain no record of such a reaction, and it is therefore mentioned because of its possible importance in connexion with textile processes where such auxiliaries are sometimes used. It may also have some value in relation to the more academic aspects of the sequestering power of sodium hexametaphosphate.

I am indebted to the Director of Research for his guidance, and to the council of the British Launderers' Research Association for permission to publish this note.

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The Donnan Membrane Equilibrium

WHEN applying the distribution law of Boltzmann to the Donnan membrane equilibrium in two compartments, one containing a mixture of colloidal ions (or non-diffusible ions) and electrolytic solutions and the other electrolytic solutions, we have to assume the compartment containing the colloid or non-diffusible ions to consist of a charged material and a double layer, which extends up to the membrane through which the colloidal particles or non-diffusible ions cannot pass. In the case of colloidal solutions, the membrane may also be considered as a plane, separating the double layer and the bulk of the solution through which the colloidal particles cannot pass. The membrane potential, E_m, might be put equal to $\psi_1 - \psi_2$, where ψ_1 is the potential of the ion positive or negative in compartment 1, containing the colloid or the non-diffusible ion, and ψ_2 is the potential of the same ion in the other compartment 2.

We have, therefore, at all values of the membrane potential,

$$q_+ (c_+)_1 + q_- (c_-)_1 = \{q_+ (c_+)_2 + q_- (c_-)_2\} \cosh \frac{N^* E_m F}{RT} \qquad (1)$$

or

$$(c_+)_1 = (c_+)_2 \cosh \frac{N^* E_m F}{RT} ;$$

where $(c_+)_1$ and $(c_-)_1$ are the concentrations of positive and negative ions in compartment 1, and $(c_+)_2$, $(c_-)_2$, the corresponding concentrations of ions in compartment 2;

$$c_+ \text{ is } \frac{q_+ (c_+) + q_-(c_-)}{q_+ + q_-}$$

$$\text{or } \{(q_+ c_+)^{q_+} (q_- c_-)^{q_-}\}^{1/(q_+ + q_-)}$$

and q_+, q_- are the numbers of positive and negative ions; and F is one faraday of electricity, R the gas constant, T the temperature, and $N^* = N_1 = N_2$ or $(N_1 N_2)^{1/2}$.

When $\frac{N^* E_m F}{RT}$ is much less than unity,

$$q_+ (c_+)_1 + q_-(c_-)_1 = q_+ (c_+)_2 + q_-(c_-)_2 \quad . \quad (2)$$

$$\text{and } \left(\frac{N^* E_m F}{RT}\right)^4 \leqslant \left(\frac{N^* E_m F}{RT}\right)^2$$

$$q_+ (c_+)_1 + q_-(c_-)_1 = \{q_+ (c_+)_2 + q_-(c_-)_2\} \left\{1 + \tfrac{1}{2}\left(\frac{N^* E_m F}{RT}\right)^2\right\} \quad (3)$$

The membrane potential is small when calculated from mean concentrations of ions, and the equation

$$(c_\pm)_1 = (c_\pm)_2 \quad . \quad . \quad . \quad . \quad (4)$$

can be deduced from equation (1).

The data of Rinde[1] on sulphur sols, of Azume and Kameyama[2] on congo red and Mattson[3] on bentonite systems show that the relations (1), (2) and (3) hold with accuracy. The relation (4) holds with much greater accuracy.

In considering the equilibrium between ions and undissociated molecules in solutions of weak electrolytes, the solution may be assumed to consist of two compartments in one of which there are undissociated molecules and ions, and in the other only ions. The uncharged solute species cannot pass into the double layer (ionic atmosphere) and therefore the principle of Donnan membrane, equilibrium is applicable. From the equilibrium

$$\begin{tikzcd}
\text{Undissociated molecules} \arrow[d, shift left] \arrow[dr, shift left] & \\
\text{Double layer} \arrow[u, shift left] \arrow[r, shift left] & \text{Bulk} \arrow[l, shift left, "\text{(Debye)}"] \arrow[ul, shift left, "\text{(Ostwald)}"']
\end{tikzcd}$$

we have

$$K = \frac{(c_{\pm})^2{}_D}{c(1-\alpha)}$$

between the undissociated molecules and the double layer, where K is the equilibrium constant, and c the concentration of the electrolyte with conductivity coefficient α and $(c_{+})_D$ is the mean concentration of ions in the double layer. The concentration of ions in the double layer may be found from the distribution law of Boltzmann and

$$K = \frac{c\alpha^2}{1-\alpha} \cosh^2 \frac{N^* E_m F}{RT} \quad . \quad . \quad . \quad . \quad (5)$$
$$= \frac{c\alpha^2}{1-\alpha} \text{ when } \left(\frac{N^* E_m F}{RT}\right)^2 \ll 1,$$

which is Ostwald's dilution law. Equation 5 is the new dilution law from which Ostwald's dilution law can be deduced

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[1] *Phil. Mag.* (57), 1, 32 (1926).

[2] *Phil. Mag.*, **50**, 1264 (1925).

[3] *Soil Sci.*, **28**, 179 (1929).

Relation of Tea 'Fermentation' to Normal Respiration

IN a recent communication, Sreerangachar[1] has criticized certain of my conclusions as to the relationship existing between the process known as tea-fermentation and the normal respiratory mechanism of the tea-leaf. In view of the somewhat divergent conclusions drawn by this author and myself[2], some further discussion of the results is desirable. Unfortunately such criticisms as are made cannot be backed up by further experiment until we are able to return to our normal peace-time activities.

The fundamental criticism made by Sreerangachar is that neither mechanical rolling nor fine mincing is sufficient to result in the disruption of every cell in the tissue, so that the fermenting leaf must be considered as a heterogeneous mixture of damaged and undamaged tissue. The implication is that in such crushed tissue some respiratory activity will persist.

Sreerangachar then goes on to describe experiments which show that finely minced tea-leaf, as obtained in his laboratory, is in fact a heterogeneous mixture of respiring and 'fermenting' tissue, and that further damage increases the $-Q_{O_2}$ and still further depresses the *R.Q.* He also succeeds in achieving some separation of the fermentation and respiration processes by washing the minced tissue with water. The washed tissue shows practically no fermentation, and as the carbon dioxide outputs of washed and unwashed tissue are not dissimilar he concludes that the carbon dioxide output in the minced tissue is largely contributed by undamaged cells.

This conclusion neglects the possibility that free polyphenols, or their oxidation products, may depress normal respiration and hence carbon dioxide outputs. In finely chopped tissue the carbon dioxide may then originate partially through carbohydrate oxidation with *o*-quinones as the hydrogen-acceptors, and partly as a result of inhibited normal respiration. It is by no means unlikely that the carbon dioxide produced by these two mechanisms will differ but little from that produced by uninhibited respiration in the intact portions of the tissue in the washed material.

Sreerangachar's experiments in which glucose is added, without effect, to an *in vitro* enzyme-substrate mixture have no bearing on the problem, as an enzyme obtained by the action of acetone on tea-leaf tissue would certainly lack many of the factors required to bring about oxidation of glucose by *o*-quinones.

Although it is admitted that Sreerangachar has demonstrated that his minced tissue preparations contain some undamaged tissue in which normal respiration persists, his claim that carbon dioxide evolved from crushed tissue comes only from undamaged cells is by no means firmly established. As shown above, an alternative explanation of these results can be advanced. In addition it may be pointed out that his own figures show, like my own, a rapid drop in carbon dioxide output after the first forty-five minutes. If carbon dioxide were a product solely of respiration one would expect the output to be maintained at or near its original level. A period of constant output followed by a rapid fall to an almost zero level is difficult to explain on Sreerangachar's hypothesis.

It has never been my belief that fermentation takes place only in completely ruptured cells. Damage such as is inflicted during mechanical rolling in manufacture is insufficient to destroy the cellular nature of the tissue, yet fermentation may take place to the extent of 95 per cent oxidation of the polyphenols present. As rolling in the factory is so efficient it follows that the extensive damage involved in grinding the tissue is not necessary for complete fermentation.

It has been my contention that the mechanical damage required to bring about complete oxidation of the polyphenols in the tea-leaf is sufficient to suppress the greater part of normal respiratory activity, and that carbon dioxide produced in fermentation is due to a secondary oxidation of carbohydrates with the *o*-quinones as one of the necessary H-acceptors. The most important items of evidence supporting this view are summarized below.

(1) The fall in carbon dioxide output when oxidation of polyphenols is nearly complete.

(2) The negligible oxygen uptakes and carbon dioxide outputs recorded for non-tanniferous tissue when subjected to the same degree of mechanical damage[3].

(3) The suppression of anaerobic fermentation in tea-leaf tissue sufficiently damaged to undergo complete oxidation of its polyphenols[4].

(4) The stimulation of both oxygen uptake and

carbon dioxide output when fresh polyphenol is added to completely fermented tea-leaf suspensions. This observation cannot be explained by Sreerangachar's hypothesis, but this effect is to be expected if carbohydrate oxidation depends upon the presence of *o*-quinones.

It is considered that the damage brought about either in the factory-treated leaf or in finely minced tissue is sufficient to suppress respiration almost completely, and that the carbon dioxide produced during fermentation is not a product of normal respiration.

Sreerangachar's results become completely intelligible if his mincing process is considered to produce less damage to the leaf than ours. In the Tocklai experiments an attachment used for grinding nuts to a fine paste was employed for the mincing of the leaf. This would be expected to produce a much greater extent of damage than a fine cutter, as in addition to chopping up the tissue it also gives it a considerable shear. It has been emphasized in my recent publications[5,6] that such shearing forces are to be considered as responsible for the disorganization of respiratory processes which results in tea-fermentation.

The effects of a fine chop, such as presumably was obtained in Sreerangachar's laboratory, have been studied at Tocklai. Such a mince gives a rather lower $-Q_{O_2}$, a certain amount of undamaged tissue which remains unfermented, and a comparatively high rate of anaerobic fermentation. There is therefore good reason to believe that Sreerangachar's results are due to a failure to repeat the conditions under which the Tocklai experiments were carried out. In addition it must be emphasized that Sreerangachar's views do not give an adequate explanation of the dependence of carbon dioxide output on polyphenol oxidation. The criticisms made by Sreerangachar are not therefore considered to weaken the theory of tea-fermentation advanced by the author to any appreciable extent.

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April 2.

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[2] Roberts, E. A. H., *Biochem. J.*, **35**, 1209 (1941).

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[4] Deb, S. B., and Roberts, E. A. H., *Biochem. J.*, **34**, 1507 (1940).

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Ascorbic Acid Content of Recently Harvested Cereals and Legumes

IN the course of an investigation, it had become necessary to start some guinea pig growth experiments for assay of ascorbic acid biologically. It was soon found that the animals kept on a scorbutic diet of casein, ground roasted Bengal gram (*Cicer arietinum*), ground oats, cod liver oil and salts did not cease to grow and show depletion even after three weeks. This unusual behaviour was ultimately traced to the ascorbic acid of the cereals and legumes in the diet. These grains were apparently harvested in March–April, and the experiment with the diet containing them started in May. The ascorbic acid contents of the cereals and pulses were estimated by titration with 2 : 6-dichlorophenol indophenol and are given in Table 1.

Table 1.

Material	Ascorbic acid content (mgm./gm.)
Bengal gram (ground and roasted) ..	10·31
Oatmeal (whole)	13·97
Wheat flour (whole)	5·30

Table 2.

No. of animals	Av. weight at start	Av. weight after 3 weeks	Mean growth for the period	Mean weekly growth
8	126 gm.	168 gm.	42 gm.	14 gm.

The ascorbic acid values found by titration have been substantiated by biological assay. Young growing guinea pigs were kept on the diet of casein, ground and roasted Bengal gram, oatmeal, cod liver oil and salts; when the total consumption of food by each animal corresponded to an average intake of about 1 mgm. ascorbic acid per animal per day, they showed a growth response of 14 gm. (mean growth-rate) per animal per week over a three-week test period (Table 2).

I have not seen any similar reference in the literature on the ascorbic acid content of dry cereals and legumes, so far.

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High-angle Edge-flaking of Flint

SOME four years ago I carried out a number of experiments in the removal of high-angle flakes from the edges of flints, and feel that examples of the results of this work should now be made public. It will be seen, from the accompanying table, that the angles at which the flakes were removed range from 100° to 140°. The greatest length, and the greatest width, of the flakes removed are also given :

Angle of detachment of flake	Greatest length of detached flake	Greatest width of detached flake
100°	2 in.	$1\frac{4}{16}$ in.
102°	$1\frac{13}{16}$ in.	$1\frac{13}{16}$ in.
105°	$1\frac{5}{16}$ in.	$1\frac{11}{16}$ in.
110°	$1\frac{13}{16}$ in.	$1\frac{2}{16}$ in.
132°	$1\frac{7}{16}$ in.	$\frac{14}{16}$ in.
140°	$1\frac{3}{16}$ in.	$\frac{15}{16}$ in.

The detachment of these high-angle flakes from the edges of large nodules of flint was accomplished by the use of a weighty hammer-stone of quartzite. No other method of detachment was adopted. In one case the removal of a consecutive series of these flakes from the edge of a flint was accomplished. These flakes were detached at angles of 102°, 105° and 110° respectively. The angles enumerated in this note are those formed between the striking-platform and the flake-scar upon the parent block. It seems probable that further practice in this work may result in the removal of high-angle edge-flaking from flints with comparative ease and precision.

I have placed a typical series of the experimental pecimens on exhibition in Ipswich Museum.

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Suffolk.

A Nuclear Ring in the Developing Male Germ Cells of the Dog and Cat

I regard Mr. Zlotnik's[1] nuclear ring in the dog spermatid as an Aoyama picture of the same post-nuclear granules drawn in Fig. 3, plate 28 of my 1929 paper[2]. The Da Fano and Cajal pictures also differ slightly in the exact amount of silvering and in the substrate in which the silver comes to rest. As mentioned in a previous communication[3], the dog spermatogenesis is in some ways clearer to study and nterpret, and in it Mr. Collery and I have been able to follow the granules of the middle piece bead rudiment right back to the early spermatocyte. As regards the human post-nuclear body, Dr. Beams and I[4] had no silver material to study. Probably osmium tetroxide impregnates the bottom of the band first, and not the top as does silver. However, Mr. Collery has recently made me some excellent slides of human material by the Aoyama technique, and I hope to study the method of formation of the post-nuclear band in the near future. Mr. Collery and I have been unable to agree with Bell's[5] account of the origin of fat from broken-down Golgi remnants in the dog. We believe the fat appears by unmasking of droplets in the peeling-off cytoplasm. I note that Mr. Zlotnik figures the neck or middle piece bead in some of his drawings. At the present moment I believe my previous account of its origin from an argentophile structure in the spermatid to be correct; but I do not think that this structure buds off from the Golgi apparatus after acrosome formation, for the reason given above. Mr. Collery and I are still working on the origin and fate of the two argentophile beads (inner and outer) associated with the middle piece of the mammalian spermatozoon, and both of which can be found in spermatids.

I am glad that Mr. Zlotnik has been able to confirm the presence of the post-nuclear body, which I have shown to be present in the spermatozoa of various animals. There is just one point in technique which I should mention: in recent work I have noted that Mr. Collery's preparations made by the Aoyama method, cut by the freezing microtome and mounted in glycerine jelly, are superior to anything I had to study in 1929. Perhaps Mr. Zlotnik already knows the valuable papers by Popa and Marza[6] which I have found very interesting, and which are not so well known as they should be.

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[1] Zlotnik, J., Nature, 151, 670 (1943).

[2] Gatenby and Wigoder, *Proc. Roy. Soc.*, 104 (1929).

[3] Gatenby and Collery, Nature, 151, 253 (1943).

[4] Gatenby and Beams, *Quart. J. Micro. Sci.*, 78 (1935).

[5] Bell, A. W., *J. Morph. and Physiol.*, 48, No. 2.

[6] Popa and Marza, *Arch. Rouman. de Path. Exper. et Microbiol.*, 4, 3–4 (September–December 1931).

Science, Christianity and Truth

Two passages in the Rev. Hardwick's review of Canon Baker's "Science, Christianity and Truth"[1] call for comment.

He writes: "Canon Baker's words are only too true: 'The scientists, because they can say nothing more of man than that he is the product of evolution, here to-day and gone to-morrow, have no reply to the Nazi or Fascist or Communist assumption that liberty is only a fad or a prejudice and the individual is nothing compared with the Race or State or Working Class'."

This appears to me so extraordinary a statement, especially in the columns of Nature, that I at first thought I must have misread it. It runs counter to modern trends in evolutionary theory[2] and in sociology[3]. In point of fact, the precise opposite is probably true, namely, that evolution (under which social as well as organic evolution is, of course, to be included) provides the only external yardstick or standard by which to measure the correctness of our social principles and our ethical judgments. This has been pointed out, for example, by Waddington[4], and later in more detail by myself[5].

Secondly, the Rev. Hardwick quotes his author, apparently with full approval, as follows: "In his remarkable chapter, 'Is there a God?', Canon Baker writes: 'If there be no other ground and cause of existence than the irrational, the meaningless, the unconscious, the blind, then there is no reason to believe that our reasoning arrives at truth rather than error. . . .' Here again we have an idea which the scholastics would have grasped at once, namely, that the existence of God is pre-supposed in all our thinking, whether we realize it or not".

Whether men of science realize this or not, the great majority of them would, I imagine, agree that their criterion of "arriving at truth rather than error" lies in correspondence with fact, and is therefore provided by the scientific method of submitting their conclusions to independent verification, and refusing to accept any conclusions which are not capable of such verification, rather than in any deductions from the "ground and cause of existence" (whatever that may imply: personally I find it difficult to attach any meaning to the idea of a cause of existence).

I direct attention to these points because there is at the present time in various quarters a marked tendency to reject the scientific point of view and to revert to a pre-scientific attitude. In particular, "Science" is accused of materialism, and its relevance to social principles and to philosophical problems is called in question. Accordingly it is of some importance for men of science to think out in the fullest possible way the implications of their subject and its method, notably perhaps in fields where values are concerned, the better to resist these attempts to restrict the scope of science and its applications.

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[1] Nature, 151, 710 (1943).

[2] See, for example, the last two essays in J. Needham's "Time: the Refreshing River"; London (1943).

[3] For a general discussion, based on the scientific approach, of desirable social trends, see the articles signed "Archimedes" in *Horizon* of July 1942 and subsequent issues.

[4] "Science and Ethics", Nature, 148, 270 (1941). Later reprinted with contributions from numerous other writers in book form: "Science and Ethics"; London (1942).

[5] "Evolutionary Ethics" (Romanes Lecture. Oxford, 1943; in the press).

Future of Technical Colleges

IN recent educational discussions changes have been suggested in the relative status of university and technical institutions. Some of the suggestions have taken form and substance in various reports, for example that of the Institute of Physics dealing with the education and training of physicists. The policies suggested have so fundamental a bearing on the future of technical colleges of the first rank that they should be made as public as possible before any irreparably damaging step is taken. One notes, for example, that the report referred to hopes to "relieve the Technical Colleges of the necessity of preparing students for External University Degrees". The elastic term technical college includes institutions of every type from the lowest to the highest rank, and the subsequent discussion and suggestions refer to those technical colleges of the highest rank, which would suffer most greatly by this step. Such a "relief" would, in the opinion of a large number of those interested in the growth of technical education, disable and de-rank big technical institutions which have rendered sterling service to technology, and have striven hard, often with little national or local interest, to become institutes of technology of university rank and status.

Whatever policies in technical education the post-war period ushers in, the standard of highest rank technical colleges, with their fine record of service and close attention to the needs of industry, should be safeguarded more than ever in a world where technology seems destined to play an ever-increasing part. Even major technical colleges have suffered too much in the past from being maintained as subordinate institutions. From this position, the only means of escape has been to become university colleges, and in the process of transition many purely technical departments have become attached to universities, the functions of which are more normally academic. This process of accretion of technical departments to universities could not but be accelerated by the move suggested by the Committee, denying as it does the right of the technical college to give the highest training to the young technologist. The best general training which can be devised is along the lines of a university degree course in technical subjects, such as chemistry, physics, engineering, pharmacy, commerce, chemical engineering, metallurgy, textile technology and the like, and no such crippling handicap should be imposed on big technical colleges and their students as denying the former the right to their proper function, and the latter their right to the highest standard of tuition there.

In our opinion, the correct development of technical education does not lie along lines of transference of all higher flights of technology to the universities. Instead there should be in Great Britain a group of institutes of technology, properly equipped and adequately financed, of definite equality in status to the universities. Such institutions exist in the Continent of Europe and in the United States. No one there, even from the universities, would think of de-ranking them. They send out a flow of graduates who take the highest industrial posts; they contribute a steady stream of fundamental research; their professors are world-famous. The lustre of the Zurich Polytechnic, or the Massachusetts Institute of Technology, to name two of many equally splendid institutions, is as bright as that of any contemporary university. It is difficult, with the totally differe example and experience of so many other countri before one, to contemplate such a retrograde ste as that recommended by the Report, which leav the technical colleges, irrespective of their standin only minor courses of National Certificate characte and only second-rate students.

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June 24.

Microchemical Apparatus

The microchemical apparatus used in Great Brita before 1939 was, in the main, imported from Austri where Prof. Pregl and his co-workers instructed con petent apparatus makers such as Paul Haack, an approved for use in the exacting microchemic technique the products they manufactured.

Chemists in Great Britain have been slow to ado micro methods. We believe this to be due to number of causes. (*a*) The lack of an active organiz tion to arrange meetings and demonstrations and t develop an interest in the subject. The Microchemic Club did something towards this end, but it is no defunct[1]. (*b*) The foreign apparatus was importe and could not, therefore, be described as bein 'freely' available. The spread of a new science greatly encouraged if the apparatus for it is easy t obtain. (*c*) Arising out of (*a*) and (*b*), the diversit of views among workers and their failure to agre how microchemical apparatus should be constructe It is true that text-books describe minutely some the special points to be observed during manufacture but many features are not clearly specified, either b illustration or by literary description. Glassblowin is an art; not a precise engineering operation tolerances have to be allowed and the closer th tolerances the greater the difficulty in manufactur and hence the greater the cost.

Until, therefore, microchemists can band them selves together for their common interest and agre what they want and how it should be made, dis satisfaction with British-made apparatus will con tinue to be expressed by some of them. In the Unite States a start has been made and some approve specifications have already been published[2].

In our view the bodies in Great Britain primaril interested should appoint a panel to draw up specifi cations acceptable to both users and manufacturers These might be the British Standards Institution the Society of Public Analysts and Other Analytica Chemists, the Chemical Society, the Royal Institut of Chemistry, various Government Departments an others concerned, and work here should be linke up with what is being done in the United States.

British manufacturers are ready and willing t give their full co-operation in any project for th standardization of apparatus for this growing science This Association would welcome collaboration wit any microchemical organization in the examination from the manufacturing point of view, of any draf specifications.

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MAGNESIUM-CALCIUM ANTAGONISM IN MUSCLE

y DR. G. D. GREVILLE and DR. H. LEHMANN
Runwell Hospital, nr. Wickford, Essex

IN skeletal muscle, the energy needed for the contraction is probably provided by the hydrolysis of adenosinetriphosphate. Adenosinetriphosphatase, the enzyme which catalyses this reaction, is intimately associated with myosin, the contractile protein itself[1]. There is evidence from experiments *n vitro* that elongated myosin molecules contract as the adenosinetriphosphate breaks down[2]. In the esting muscle fibre, the adenosine compounds are spatially separated from the myosin, the former being in the isotropic and the latter in the anisotropic egments; during activity the adenosine compounds migrate into the segments containing the myosin[3].

The adenosinetriphosphatase of myosin is activated by calcium ion[4,5]. Ljubimova and Pevsner[6] have eported some inhibition (*ca.* 30 per cent) by Mg++. During a study[7] of the enzymes of human tissues, however, we prepared human myosin and found that Mg++ powerfully suppresses the Ca++ activity. With very dilute rabbit myosin, where addition of Ca++ is essential, the activity in presence of 2×10^{-3} *M*.CaCl$_2$ was reduced by 82 per cent when as little as $2 \cdot 5 \times 10^{-4}$ *M*.MgCl$_2$ was present (Fig. 1).

Mg++ thus overcomes the activation of adenosinetriphosphatase by Ca++; but to determine whether this is a result of competitive inhibition, it had to be ascertained whether the inhibition by Mg++ decreases when the Ca++ concentration is raised above a value already causing maximal activation. A difficulty arose here because there is only a narrow range of Ca++ concentrations over which the activaion is maximal, since the activity falls off at higher Ca++ levels (Fig. 1). However, it was the same with 2×10^{-3} *M*.Ca++ as with 4×10^{-3} *M*., whereas the same Mg++ concentration was less inhibitory at the higher of these two Ca++ levels. This is strong evidence for a competitive inhibition of Ca++ activation by Mg++.

It occurred to us at once that this antagonism might be of significance in the so-called 'magnesium narcosis'[8], which is of clinical interest since MgSO$_4$ has been injected in combination with general and spinal anæsthetics, and is used in psychiatry to 'soften' the convulsions of metrazol therapy. The 'narcosis' consists primarily of a paralysis, of peripheral origin, of the skeletal musculature, which passes off immediately on the injection of CaCl$_2$. It is thus an outstanding example of Ca-Mg antagonism *in vivo*; but before discussing whether our observations can elucidate any *in vivo* phenomena, two possible objections must be considered.

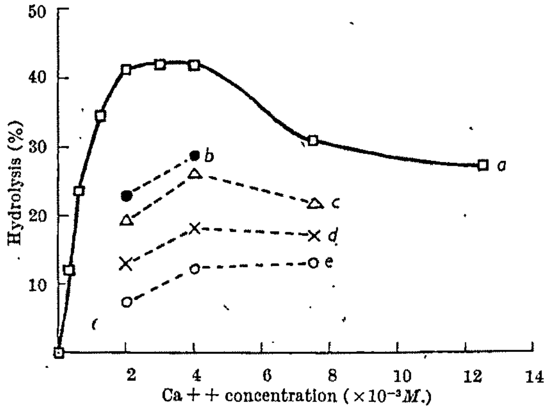

Fig. 1. Ca + + activation of rabbit myosin adenosinetriphosphatase; competitive inhibition by Mg + +. 150 sec. at 37°. 0·05*M*. glycine buffer *p*H 9·2. Per ml. reaction mixture: 0·0054 mgm. protein -N, 0·069 mgm. adenosinetriphosphate (as '7 min. P$_2$O$_5$'). Total vol. 4 ml. Concentration of MgCl$_2$ (*M*. × 10^{-5}): *a*, 0; *b*, 3; *c*, 6; *d*, 12·5; *e*, 25 (Hilger Absorptiometer used in phosphate determinations).

"Hydrolysis (%)" in Figs. 1 and 2 refers to one phosphate group, since 100% hydrolysis by myosin releases only one of the three phosphate groups of adenosinetriphosphate.

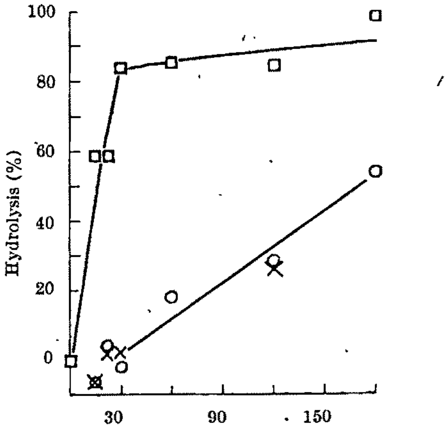

Fig. 2. High concentration of myosin, *p*H *ca.* 7; Ca + + activation and its inhibition by Mg + +. 37°. Per ml. reaction mixture: 1·2 mgm. protein -N, 0·305 mgm. adenosinetriphosphate (as '7 min. P$_2$O$_5$'). Total vol. 1 ml. ○, no addition; □, 0·01 *M*.CaCl$_2$; ×, 0·01 *M*.CaCl$_2$ + 0·01 *M*.MgCl$_2$.

First, as is usual with myosin, the above experiments were carried out at the unphysiological *p*H of 9·2. We have found, however, that Mg++ still overcomes Ca++ activation at *p*H *ca.* 7, both in presence of glycine buffer, and also (Fig. 2) when the sole buffering is provided by the myosin and adenosinetriphosphate.

Secondly, high concentrations of myosin show adenosinetriphosphatase activity in the absence of added Ca++, even with repeatedly washed protein[5]. We have found that it is much less affected by Mg++ than is the catalysis activated by *added* Ca++; as much as 0·04 *M*.MgCl$_2$ reduces it only by 35 per cent. It might therefore be objected that in muscle, where the myosin is highly concentrated, the adenosinetriphosphatase activity should be insensitive to Mg++. However, using myosin in fairly high concentrations, and measuring the activity over short time-periods (Fig. 2), we found that after thirty seconds the reaction in presence of calcium was almost complete, whereas in absence of Ca++ the conversion was negligible. Furthermore, addition of Mg++ had completely suppressed the activity induced by Ca++.

Hence if muscle twitches, which are of very short duration, fail to appear under the influence of Mg++, the enzymological evidence permits the explanation that the effect is due to inhibition of the myosin adenosinetriphosphatase. In the *frog*, this is probably the case in the later stages of the narcosis, since after injection of MgSO$_4$ into the dorsal lymph-sac the leg muscles ultimately fail to respond to direct electrical stimulation[9]. Further, when denervated frog muscle, and also single fibres, are transferred from Ringer solution to isotonic MgCl$_2$ solution, the threshold of response to electrical stimulation is raised[10].

In the *mammal*, however, present knowledge of the muscular relaxation immediately following $MgSO_4$ injection makes it unlikely that this can be ascribed to a direct action of Mg^{++} on the contractile protein, for two reasons:

(1) It is generally realized that when Mg^{++} is injected and produces muscular relaxation, it does not paralyse the muscle directly. It acts in a similar manner to curare, which interrupts transmission at the neuromuscular junction. Thus following the injection of Mg^{++} or curare, the response to direct stimulation remains when that to indirect stimulation has disappeared[11], the latter is temporarily restored after tetanization[12], and similar chronaxie relationships are observed[13].

(2) After the intravenous injection of $MgSO_4$ into dogs, the Mg^{++} most probably distributes itself through the extracellular fluid of the body[14] and is thus unlikely to come into contact with myosin.

In a paper which has just reached us, DuBois *et al.*[15] put forward as an explanation for magnesium narcosis the mechanism which we have been considering, namely, that Mg^{++} competes with Ca^{++} and prevents the breakdown of adenosinetriphosphate. This hypothesis must be rejected for the reasons given above. The increased adenosinetriphosphate content of the muscles of animals under magnesium narcosis, which is the sole evidence adduced by the American authors, might well be due to the relaxation; it remains to be shown that curare would not give the same effect.

Furthermore, the antagonism between Ca^{++} and Mg^{++} is not unique for myosin. The adenosinetriphosphatase activity of the electric organ of Torpedo[16], which is not due to myosin, is activated by Mg^{++}[17]. We have found that here Ca^{++} is inhibitory.

Electric organ extracted with 1·5 vol. of water. In each tube, 0·4 ml. extract, 1 ml. glycine buffer *p*H 8·2 (37°); 0·42 mgm. adenosinetriphosphate (as '7 min. P_2O_5'), total vol. 2·5 ml. 10 min. at 37°.

	—	*M*/250 $CaCl_2$	*M*/250 $MgCl_2$	$MgCl_2$ $+CaCl_2$
% of 7 min. P_2O_5 hydrolysed	17	6	45	7

It seems probable that this antagonism is widespread, so that when one of these ions is an activator, the other may be expected to be inhibitory. If in neuromuscular transmission some enzyme process is activated by Ca^{++}, and it is noteworthy that a dependence on the Ca^{++} level has been shown[18], Mg^{++} might be expected to suppress it. Thus for magnesium narcosis our observations may serve only as model experiments. There is, however, one phenomenon in the mammal for which they may offer a direct explanation.

Magnesium deprivation tetany in the rat is in some ways the converse of the paralysis following magnesium injection, the hyper-irritability increasing when the calcium level of the diet is raised[19]. Since the threshold of response of the leg muscles to galvanic stimulation of the motor nerve is lowered[20], and curare does not decrease the severity of the convulsions[19], it is possible that the hyper-irritability arises *in* the muscles. Although the mammalian muscle cell is probably impermeable to *injected* Mg^{++} [14], its magnesium content is high[21]. Conceivably a lowering of this level by magnesium deprivation might lead to accelerated adenosinetriphosphate breakdown by myosin, with exaggerated response to motor stimuli and the appearance of tetany.

We are grateful to Dr. R. Ström-Olsen, physician superintendent of Runwell Hospital, for his encouragement; to Drs. D. M. Needham and K. Bailey, of the Biochemical Laboratory, University of Cambridge, and Drs. G. L. Brown and F. C. MacIntos of the National Institute for Medical Research, wit whom these problems have been discussed.

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RECENT ADVANCES IN IMMUNOCHEMISTRY*

By Dr. W. T. J. MORGAN
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ALTHOUGH methods for protecting man an animals against certain infectious diseases hav been known for many years, it is only within the la decade that the nature of the substances that indu this resistance have been at all clearly defined an their composition and structure expressed in terms the fundamental sciences, chemistry and physics.

At first it was believed that the strict specifici of bacterial antigens—the substances inducing t formation of the immune bodies that protect again infection with the homologous micro-organism depended largely on the chemical and physical diffe ences that existed between the bacterial proteins the different kinds of organisms. This view w abandoned when it was shown that filtrates fro virulent bacterial cultures contained a soluble specif polysaccharide substance and appeared to be fr from intact protein. The specific polysaccharid which were found to be responsible for the chara teristic specificity of each organism were, howeve shown to be devoid of antigenicity, or at most show this property only weakly. The results of the researches on the specific polysaccharide componen of the whole bacterial antigen were of the greate importance because later studies, which developed a direct result of this work, formed the basis of o present knowledge of antigenic structure.

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* Substance of a lecture before the London and South Easte Counties Section of the Royal Institute of Chemistry on June 1

Until quite recently no attempt to separate the somatic antigens from the bacterial cell had been successful, but within the last ten years several methods for the isolation of fully active bacterial antigens from Gram negative organisms have been elaborated. The earliest practical method to accomplish this was introduced by Boivin, who extracted bacteria at 0° with $0 \cdot 2$ *N.* trichloracetic acid (*p*H $1 \cdot 0$–$2 \cdot 0$). The extract was apparently free from intact protein and was powerfully antigenic. At about the same time and quite independently, Raistrick and Topley found that by the action of trypsin on certain bacteria it was possible to bring the antigenic complex into solution. The digestion was carried out at *p*H $8 \cdot 2$–$8 \cdot 5$ for several days at 37°. Methods of isolation that depend on extraction of the bacteria with cold anhydrous organic solvents, such as diethyleneglycol, in which native proteins and many bacterial somatic substances are insoluble, have also been successfully employed to isolate these important biological complexes.

It is certain that as our knowledge of the nature of the bacterial somatic antigens grows, we shall find very different types of chemical structures associated with bacterial and tissue antigenic complexes. We already know, however, that certain groups of bacteria possess antigens that are built up from similar types of molecules arranged together as polymolecular aggregates. As an example of this similarity in structure the *O* somatic antigens of *Bact. typhosum* and *Bact. dysenteriæ* (Shiga) may be mentioned. Each antigen is built up of a polysaccharide, specific for the organism and responsible for its characteristic serological reactions, and a polypeptide-like component (most probably a conjugated protein). Other components of the native antigenic complex, such as phospholipin, also occur, and it is possible that further unidentified substances are present.

In certain instances, however, it has been shown that of all the components present in the native antigenic complex only two, the polysaccharide and protein, are essential for the manifestation of antigenicity. It seems probable, therefore, that a bacterial antigen as it exists in the intact bacterial cell is not a simple compound of rigid chemical composition, but consists of a labile molecular aggregate possessing an essential component—such as a polysaccharide—of definite chemical structure and of fixed composition, which determines the strict specificity of the antigen, together with other loosely bound constituents which endow the essential component with antigenic properties. Only part of these physically associated molecules are necessary for the manifestation of the specific antigenic properties, and certain of these constituents can be dissociated from the labile complex during the isolation and purification of the antigen without producing more than a moderate reduction in the antigenic capacity of the active material. More thorough physical disaggregation of the polymolecular complex into single types of molecules will lead to complete loss of the original antigenicity that gives rise to the homologous immune body.

Considerable support for this conception of antigenic structure was obtained when it was observed that the isolated and undegraded specific polysaccharide component of the antigen could be re-combined with the conjugated protein component, under almost physiological conditions, to form an antigenic complex that would give rise to antibodies specific for the polysaccharide component of the newly formed complex. Neither component showed any specific antigenic properties when tested alone. Furthermore, it has been found that the non-antigenic, specific polysaccharide of one organism will form an antigenic complex when combined with the conjugated protein component derived from the corresponding somatic antigen of another organism that belongs to an entirely different bacterial species. The nature of the bonds that hold the different types of molecules together as a polymolecular aggregate is unknown. Future work will certainly decide whether the association of the various component molecules is due to 'salt-like linkages', hydrogen bonds, van der Waals' forces or to some as yet unknown mechanism. It can only be stated at the present time that the forces concerned give rise to an aggregate with sufficient stability to make it behave as an independent molecular species.

Further evidence in support of these ideas on antigenic structure is derived from the success with which certain non-antigenic polysaccharides of both vegetable and animal origin have been converted to full antigens by combination with the reactive bacterial conjugated protein mentioned above. The artificial antigens again give rise to immune body that reacts specifically with the polysaccharide component used to build the antigenic complex.

Antibodies against the polysaccharides agar-agar, cherry gum and gum acacia have been described, and more recently immune sera capable of specifically agglutinating human *A* red blood cells but not those of groups *B* and *O* have been prepared by combining a naturally occurring but non-antigenic polysaccharide complex that possesses blood group *A* specificity with a bacterial somatic conjugated protein. It is believed that these powerful anti-*A* sera will be useful in certain blood-group determinations and will prove to be of value in the technique of differential agglutination.

It is clear that bacterial and tissue antigens that are largely polysaccharide in nature belong to a class of substances that are characterized as 'large molecules'. They display unusual properties and it will be necessary to develop new methods for handling them and new chemical conceptions to explain their nature and function.

RADIO RESEARCH ON METRE WAVES

THREE papers by members of the staff of the Radio Department of the National Physical Laboratory appear in the March issue of the *Proceedings of the Wireless Section of the Institution of Electrical Engineers.*

The first paper, on a study of the propagation of ultra-short waves between Guernsey and England, by Dr. R. L. Smith-Rose and Miss A. C. Stickland, was referred to in NATURE of January 2, p. 31.

Following this is a paper by Messrs. F. M. Colebrook and A. C. Gordon-Smith, entitled "The Design of Ultra-Short Wave Field-Strength Measuring Equipment". This comprises a description of the essential features of design and construction of apparatus for measuring field-strength, and suitable for any radio-frequencies between 30 and 600 megacycles per second; that is, wave-lengths between 10 and $0 \cdot 5$ metres. The equipment is of a relatively narrow band width type (about 20 kc./s.), and is primarily intended for the measurement of continuous-wave fields of the order of tens or hundreds of microvolts per metre. The description is supplementary to a previous paper on the subject which dealt with measurements at wave-lengths down to about 7 metres. For shorter wave-lengths than this, a half-wave-length dipole is the most practicable form of aerial, and this is coupled to the frequency-change unit by a flexible transmission line. For wave-lengths less than about one metre, it is an advantage, from the viewpoint of ease of operation and increase in sensitivity, to use a flat sheet reflector behind the aerial, together with a shorter transmission line. The frequency change unit incorporates a diode, and it is convenient to operate the local oscillator at one half or one third of the signal frequency.

The measurements made with this equipment rest ultimately upon the intermediate-frequency amplifier, which can be calibrated for gain over a wide range. Such calibrated amplifiers have been developed at the National Physical Laboratory, and used extensively for field work: an improved version has been developed for laboratory work, and the more important features of this have been incorporated in a commercial form of the field equipment. In operation at the higher frequencies, it has been found necessary that the complete assembly should be thoroughly screened: the batteries are contained in a separate metal box and connected to the amplifier and frequency-change units by screened flexible leads and screened plugs. The overall calibration of the complete equipment is carried out by the measurement of a known, preferably horizontally polarized, field produced by a radiation method described in a previous publication.

The third paper in the series is by Dr. J. S. McPetrie and J. A. Saxton, and is entitled "The Determination of the Electrical Properties of Soil at a Wave-length of 5 Metres (Frequency 60 Mc./s.)". This gives an account of experiments made to determine the electrical properties of various ground surfaces from the reflexion coefficient obtained for radiation at normal incidence. The experimental technique used a horizontal transmitting aerial set at a height of about 12 m. above the ground; and the stationary wave pattern formed between this aerial and the ground was explored by observing the current induced in a horizontal receiving dipole placed at various heights. The observed results showed good agreement with theoretical curves calculated on the assumption that reflexion takes place actually at the ground surface. The sites investigated varied from wet clay to gravel; the corresponding values of dielectric constant ranged from about 5 to 60, while the values of conductivity varied from less than 10^8 up to, but not greater than, 10^9 E.S.U.

The lowest values in each case refer to a site which had been excavated to a depth of seven feet, exposing a surface of pure gravel, with no sign of humus or decayed vegetation. A nearby undisturbed site on the same subsoil, but with about nine inches of grass-covered soil on top, gave a reflexion coefficient similar to that obtained on other grass-covered sites. The above values of the electrical constants obtained with undisturbed soil agree with those measured in the laboratory for samples of similar types of soil. The experiments were made during winter months under rather wet conditions: the values of both dielectric constant and conductivity would probably be less during the summer.

FORTHCOMING EVENTS

Friday, July 16—Monday, July 19

Association of University Professors and Lecturers of th Allied Countries in Great Britain (at New College, Oxford).

Saturday, July 17

At 9.45 a.m.—Separate Meetings of Sections.

At 2.30 p.m.—Collective Groups of Meetings.

Sunday, July 18

At 10 a.m.—General Meeting.

Monday, July 19

At 10 a.m.—International University Conference of the Associatio of University Teachers.

Wednesday, July 21

Institute of Fuel (in the James Watt Memorial Institute, Grea Charles Street, Birmingham), at 2.30 p.m.—Mr. L. W. Andrew an Dr. E. A. C. Chamberlain: "Radiant Heat for Industrial Processes—'Infra-red' by Gas".

Friday, July 23

Royal Aeronautical Society (at the Institution of Mechanica Engineers, Storey's Gate, Westminster, London, S.W.1), at 5.30 p.m —"The Education and Training of Aeronautical Engineers".

APPOINTMENTS VACANT

Applications are invited for the following appointments on o before the dates mentioned:

Speech Therapist (full-time)—The School Medical Officer, Town Hall, Ealing, London, W.5 (July 22).

Responsible Teacher of Engineering in the Batley Technica College and School of Art—The Director of Education, Educatio Offices, Batley, Yorks. (July 22).

A post on the Chemical Research Staff of the Tin Research Institute—The Secretary, Tin Research Institute, Fraser Road Greenford, Middx. (July 24).

Combined post of full-time (acting) Radiotherapist to the Liverpool Cancer Control Organization and (acting) Medical Director of the Radiotherapeutic Department of the Liverpool Radium Institute—The Hon. Secretary, Liverpool Cancer Control Organization, 66 Rodney Street, Liverpool 1 (July 24).

Headmaster of the Day School attached to the South-West Essex Technical College and School of Art, Walthamstow—The Chief Education Officer, County Offices, Chelmsford (July 24).

Women Psychiatric Social Workers at the Birmingham Child Guidance Clinic—The Chief Education Officer, Education Office, Margaret Street, Birmingham 5 (endorsed 'Psychiatric Social Worker') (July 29).

General Manager and Engineer of the Sheffield Water Undertaking—The Town Clerk, Town Hall, Sheffield 1 (July 31).

Speech Therapist (full-time)—The Secretary for Education, Education Offices, York (August 6).

Chemist and Assayer on the establishment of the South African Mint, Pretoria—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, London, W.C.2 (August 31).

Heads of the Departments of Physiology, Medicine, and Surgery—The Bursar, Royal Veterinary College and Hospital, at The University, Reading (October 1).

Chair of Naval Architecture—The Acting Secretary of University Court, The University, Glasgow (October 4).

Science and Mathematics Master at the English High School for Boys, Istanbul—The British Council, 3 Hanover Street, London, W.1 (endorsed 'Istanbul').

Analyst and Animal Nutrition Assistant (temporary)—The Principal, Harper Adams Agricultural College, Newport, Shropshire.

Psychiatric Social Worker—The Medical Superintendent, Springfield Mental Hospital, Tooting, London, S.W.17.

Teacher of Mathematics and Science in the Junior Technical School (temporary)—The Clerk to the Governors, North-East Essex Technical College and School of Art, Colchester.

Assistant Engineer for the Government of Northern Rhodesia Public Works Department—Ministry of Labour and National Service, Central (Technical and Scientific) Register (Reference E.697), Alexandra House, Kingsway, London, W.C.2.

Engineer (Mechanical) to carry out work of national importance—The Ministry of Labour and National Service, Central (Technical and Scientific) Register (Reference No. C.1660), Alexandra House, Kingsway, London, W.C.2.

Industrial Planning Officers (9) (Reference No. C.1771), and Assistant Industrial Planning Officers (6) (Reference No. C.1772), for the Aeronautical Division of the Department of Supply of the Government of India—The Ministry of Labour and National Service, Central (Technical and Scientific) Register (quoting appropriate Reference No.), Alexandra House, Kingsway, London, W.C.2.

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LEADERSHIP IN A DYNAMIC SOCIETY

THERE is a striking parallelism of thought between the address on "Science and its Changing Social Environment" which Prof. P. W. Bridgman, of Harvard University, delivered to the American Physical Society on January 23, and that of Mr. Herbert Morrison to the Yorkshire Regional Council of the Labour Party at Leeds on April 3.

Prof. Bridgman's opening remarks on the relations of science and society, with his insistence that men of science should not acquiesce too readily in the implication of social responsibility for their discoveries, because society is the servant of science even more, and in a more fundamental sense, than is science the servant of society, are a challenge to lucid thinking in a field where terms are by no means clearly defined or precisely used. Even more fundamentally he directs attention to a danger referred to by Mr. Morrison, of which many scientific workers appear as yet to be unconscious.

In the long run, it is true that society is a better place for everyone when there is intellectual freedom and encouragement and flourishing activity in pure science. Prof. Bridgman urges that now is the time to insist more than ever that society must conform to the pattern of service to science. He suggests that changes now taking place are worsening the position of those who think as compared with those who do not. Social institutions are changing rapidly, and if society is to become a place where intellectual activity is encouraged and intellectual ability prized, those who think must fight for it. If they do not, we cannot assume that society will evolve so that the individual will be allowed to engage in independent intellectual activity.

Prof. Bridgman enters a sturdy defence of the old American conception of democracy as equal opportunity for ability to rise to its natural level, and he challenges outright a social philosophy that attempts to set any upper limit to the value of the contribution which a man of unusual ability can make to his society, particularly in time of war. Our conviction, he says, has not been strong enough that a society is a good society in which intellectual ability is prized and rewarded. We are passively accepting a change in the economic system by which the relative position of all intellectual workers, including the scientific worker, is being debased and in which assurance and commitments made by society in the past are being needlessly scrapped.

In facing this situation, our primary task, Prof. Bridgman urges, is one of education. We must make and seize our opportunity to proclaim our conviction that a society in the long run is the best society where those who have the ability are given every opportunity and inducement to practise the pursuit of truth and of understanding. We must teach our youth a social philosophy which recognizes that society is a means and not an end, and we must give them a technique by which they can discover those ends which they can accept with intellectual integrity as making society worth while.

Prof. Bridgman's views will no doubt meet with some criticism, but there are many scientific workers in Great Britain who will welcome this outspoken appeal for clear thinking. At least we owe it to our American comrades in arms to understand the trend of their thought in this question of international as well as national import. The reflexion of so much of its thought in Mr. Morrison's speech is the more suggestive for this very reason.

Mr. Morrison's address was concerned primarily with the relations between the State and industry in their threefold aspect of full employment, productive efficiency, and wide and fair distribution of the products of industry. The picture he drew of some of the effects of monopoly in a substantial fraction of British industry in the period between the Wars, with the decline of real enterprise, of thinking, planning and invention, and a decline in boldness and the spirit of adventure, is no fanciful picture but a sober warning. It is uncomfortably reflected even to-day, for example, in far too many utterances of the commercial interests to be disregarded.

"A case can be made for private enterprise," said Mr. Morrison, "in appropriate fields There is a very powerful case for public enterprise. There is no case whatever for private unenterprise, for private ownership and control without the spur either of a free market and free competition or of real social purpose. . . . An industry which makes security its sole aim is a menace. Unless private enterprise is prepared to take the risks which are its historic function, private enterprise has no function."

That was well said, and the warning was needed if only as a spur to the fundamental thinking about the relations of State and industry, and the balance between public and private enterprise, that are required if we are to evolve the new social technique or control without which planning may lead us into fascism and totalitarianism. Mr. Morrison spoke wisely also about this very question of control, which he visualized not as restrictive but, given the right methods and the right men, as constructive and stimulating. The dangers of restriction have been clearly emphasized in such studies as Dr. Hermann Levy's "Retail Trade Associations", and it is a main purpose of Prof. W. H. Hutt's "Plan for Reconstruction"* to deal with and overcome these dangers.

In the new controls to be developed, Mr. Morrison discerns four elements: expert knowledge of the industry, labour, expert knowledge of the needs and interests of the consumers, and the State. The essential problem is to devise the appropriate means by which these interests and elements can function harmoniously. The State, Mr. Morrison considers, should be represented by officers specially trained to understand and work with industry, whose duty is to watch the interest of the community as a whole. If they have a bias, they should be consumer-minded rather than producer-minded, in order to ensure efficient public-spirited control. Efficiency auditing rather than price control is what is required, and cost accounting should develop into a professio which should be the watch-dog of public interest.

Guided and informed in this way, Mr. Morriso believes that our monopolies could be made to serv the public need and to promote an expanding an not a restrictionist economy. An industry whic consciously pursues social ends can be invigorate thereby as much as by the spur of competition an the free market. He visualizes a place for publi ownership where appropriate, and a place for privat enterprise also with public control, and resting upo and supporting national policies of social and industrial welfare.

This challenge to closer and more constructiv thinking about the relations of State and industry with its warning about the danger of a policy o restrictionism, finds its reflexion not only in Prof Bridgman's address but also in other quarters in th United States. Much the same ideas, for example have been expressed in the American periodica *Fortune* in different terms. Here reliance appears t be placed on the enforcement of the anti-trust laws but the danger of restrictionism is recognized a clearly as by Mr. Morrison, and the objective i essentially the same: an economy in which freedom of enterprise is preserved side by side with the socia control essential to secure certain minimum standards

The point is that freedom of enterprise mean enterprise and expansion, not restrictionism, with al that is inherent in the idea of adventure and willingness to accept risk. Without that spirit, neither i science nor elsewhere can we make the advances i thought and in technique that are essential if a new world order is to realize the hopes that the present struggle has stimulated. It is not enough just to think of the opportunities which the general loosening u of our social structure under the impact of total wa undoubtedly gives us. These opportunities must b approached in the right spirit, seized and explored by creative and fertile minds, alive to the issues involved and willing to examine them and to turn them not to personal advantage only but also to the benefit of mankind.

The great danger is in fact what Prof. Hutt refers to as the frozen imagination of statesmen and officialdom, which refuses to recognize that the present economic arrangements and the ideas on which they are based are antiquated and obsolete, leading to inequality, a substratum of poverty, and insecurity. Under the cloak of a spurious superficial orderliness, due to imposed uniformity and rigidity, our productive arrangements have become increasingly chaotic and unco-ordinated. Productive power has been withheld or exterminated in the interests of the private incomes of sets of capitalists and workers, while technical developments which cause capital values to fall are usually regarded as a threat to prosperity.

Prof. Hutt argues cogently that security, peace and prosperity all depend on the creation of a new order from which the right to restrict production has been banished, and this belief is the foundation of the plan for reconstruction which he outlines in detail in his book. He would reserve for the State only those basic functions with which the very human and fallible men who form governments can be entrusted, but the planned system for directing the use, under continuously tested foresight, of all the resources in the community, would give our democratic institutions an organized transition away from the authoritarian and monopolistic influences which have been frustrating the forces of order and co-operation.

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* Plan for Reconstruction: a Project for Victory in War and Peace. By Prof. W. W. Hutt. (International Library of Sociology and Social Reconstruction.) Pp. viii+328. (London: Kegan Paul and Co., Ltd., 1943). 18s. net.

This plea for both freedoms—freedom to work and plan for the full use of the resources of the community in an expanding economy—is one that is not always easy to follow in its details, but as an attempt to invent or develop new institutions appropriate to the needs of to-day it merits careful consideration. As such, however, it challenges many preconceived ideas, among them the functions and organization of professional workers, and the chapter on professional security is one that claims serious attention from scientific workers. Dealing specifically with the medical profession by way of illustration, the principles Prof. Hutt outlines are intended to be applied in the organization of any profession.

There can be no question that professional organization, however sincerely conceived as an attempt to maintain high standards of professional qualification and practice in the public interest, tends, especially in a legally 'closed' profession, to become unduly conservative both towards advances in professional technique and practice, and towards entry into the profession, as well as unconsciously to place the security and interests of the profession before that of the community in general. This is a natural and possibly inevitable tendency, and Prof. Hutt's proposals represent an attempt to reconcile the interests of a profession and those of the public. He suggests a system of independent control which, while protecting established income rights, would prevent professional organization standing in the way of equality of opportunity and efficient services, opening the entrance to the professions so that the availability of family income to pay for training does not act as a major selective factor.

In what he says of the organization of the medical profession, Prof. Hutt has entered boldly on controversial ground, but the issues he raises must be frankly faced in the discussions now proceeding on the establishment of a State Medical Service; and the more general questions cannot be evaded by scientific workers who are concerned to make their full contribution in the task of post-war reconstruction. Like Prof. Bridgman and Mr. Herbert Morrison, he should stimulate some fruitful and fundamental thinking about the relations of society and science, the mechanics of living in an ordered but progressive society, developing new techniques of social control to serve its changing and growing needs. The clash between freedom and control, individualism and co-operation, the deep paradox and conflict of feelings in the lives of men which is reflected in the institutions they set up to serve their purposes, is given fairly enough, though perhaps not quite so clearly as by C. I. Barnard, whose study of the functions of the executive has a relevance here which deserves attention.

The belief in the power of the co-operation of men of free will to make men free to co-operate; that only as they choose to work together can they achieve the fullness of personal development; that only as each accepts a responsibility for choice can they enter into that communion of men from which arise the higher purposes of individual and of co-operative behaviour—these beliefs, like Barnard's further belief that the expansion of co-operation and the development of the individual are in mutually dependent realities, and that a due proportion or balance between them is a necessary condition of human welfare, are inherent in the views of Profs. Hutt and Bridgman and of Mr. Morrison. It may well be that in his keen analysis of co-operative systems and the structure and functions of organizations in such systems, Mr. Barnard has given us valuable clues for the evolution of the new forms of organization required to serve our new purposes, and for the failure of the old. Certain it is that we must heed his warnings concerning the disregard of informal organization, the recognition of the physical, biological and social factors in co-operation and the confusion of morality with responsibility. The strategic factor in co-operation generally, he reminds us, is leadership. In the dynamic expression of leadership it is moral creativeness, preceding, but depending upon, technical proficiency and the development of the appropriate techniques.

THE AMARAVATI SCULPTURES

Amaravati Sculptures in the Madras Government Museum

By C. Sivaramamurti. (Bulletin of the Madras Government Museum, New Series—General Section, Vol. 4.) Pp. xviii+376+45 plates. (Madras: Government Press, 1942.) 14.8 rupees.

THIS work is essentially a description of those sculptures and inscriptions of the Amaravati Stupa which are now preserved in the Madras Museum. There are also important slabs in the British Museum; and if they seem there to be as much out of place as the Elgin Marbles, some excuse may be found in the story of their discovery and the dissolution of the monument. It was discovered in 1797 by Colonel Colin Mackenzie of the Trigonometrical Survey at Amaravati, a town on the south bank of the Krishna some sixty miles from the mouth. A local landowner was found to be removing the materials for the establishing of a new town. The Muslims were also removing marbles for their mosques, and they appear to have taken care to efface all signs of idolatry from the slabs.

The story of its subsequent disintegration is not a cheerful one. Nothing of the original stupa now remains, but a good idea of the form of the structure can be gained from the stupas represented on the carvings. The Buddhist stupa, a development of the tumulus, consists, in its Indian form, of a solid hemispherical stone body raised on a low cylinder (in this case about the height of a man) and surmounted by a square structure called the *harmikā*. In the centre were preserved the relics, either bodily remains or other objects of devotion. At Amaravati the whole was surrounded by a carved railing with four gateways, and it was chiefly this railing and the corresponding cylindrical portion of the stupa that contained so many of the carvings, scenes from the life of Buddha or from his lives in previous incarnations, as well as designs of free artistic invention.

The stupa was described in a monograph by James Burgess in 1887, but Dr. C. Sivaramamurti, curator of the Archæological Section, Madras Museum, has now been able to do the work more completely, and especially to discuss the inscriptions in detail. He makes four sculptural periods extending from 200 B.C. to A.D. 250. The sculptures are discussed from two points of view. He first analyses the details of the scenes, the gods, animals, articles of dress and furniture, ornaments, arms, etc. This is the most original part of his work, and his own beautifully executed drawings in plates I–XIII increase its importance. There is no doubt that Western scholars have often been unable to recognize the nature of the objects in Indian designs, and this is the kind of thing that only an Indian can properly undertake. The author's knowledge seems to be much more at home in Hindu literature than in Buddhistic, and it can scarcely be expected that he has always said the last word.

In the second place, he undertakes to identify the scenes portrayed in the carvings with the events as recounted in the Buddhist legends. The two main divisions of Buddhism after the second Council, he tells us, were Thera and Mahasanghika. The school of the Theras is that now represented by the Pali Buddhism of Ceylon, and certainly with that we have nothing to do. He appears to identify the schools found at Amaravati with branches of the Mahasanghika, and yet although we have a large collection of legends in a well-known Mahasanghika work, the *Mahāvastu*, he never once appeals to it, nor does he ever directly quote the *Lalita-vistara*, another rich collection of legends. The result is that, by depending on the Pali documents, he has misinterpreted some of the scenes and failed to recognize others. Even his references to the Pali are only to translations, so that he is quite at the mercy of the whims or errors of the translators. That is the reason why he absurdly introduces angels and archangels into Buddhist mythology—merely because one erratic translator objected to speaking of gods or devas. Sometimes he sees the difficulties in which he is landed, as in the miracle of the Rose-apple Tree. The story is that once while Buddha meditated under the tree the shadow of the tree stayed still. According to the Pali, this took place when he was an infant. But in the sculptural scene he is a young man, and that is how he is described in more than one Sanskrit account. Yet the author, although he sees that the Pali version does not fit, proceeds to give it, and finally quotes Kshemendra, a Mahayanist poet who lived some centuries later than the date assigned to the sculpture. So, too, in the story of Sujātā. She was a girl who offered food to Buddha just before his enlightenment. But in the sculptured scene (which is mutilated) there are at least six girls, and the author speaks of "attendants". But in the Pali account, which he follows, the only attendant is a slave girl. Here, too, he has missed the real legend, in which Sujātā is the last of a troop of ten village girls.

The inscriptions, numbering a hundred and twenty-six, are mostly in a Middle Indian dialect, and have evidently been very carefully examined with due reference to earlier decipherers. They are chiefly dedicatory formulæ of a few words, such as, "Pious gift of the lay woman Sivalā with her sons and daughters". Many of them record the gift of a pillar, a slab, or a cross-bar. They are interesting in throwing light on the kind of people who contributed to the building of the structure—laymen and lay women, monks and nuns, merchants, bankers, and whole townships. Much the longest inscription is one of forty-seven lines in Sanskrit, giving the genealogy of a dynasty of Pallava kings. It is imperfect at the end, and the dedication, if any, has disappeared. It is remarkable that the author, who has much to say about other dynasties of South India, here makes no comment, and even ignores the description of Burgess. Some explanation of this silence appears to be wanted.

Indian authors are very much at the mercy of the Indian printer, so that in the matter of exact recording not all blame can be attributed to the author. Nevertheless, the result in the present case is unfortunate, and scholars are not likely to be satisfied without seeing the originals or rubbings of them. The single plate containing photographs of the rubbings of seventeen inscriptions does not carry one very far.

The author has collected much historical information about the Andhras, who occupied much of the Deccan during the most flourishing period of the stupa. He also gives what passes as the history of the earlier period of Buddhism according to the Pali tradition, but these matters do not throw light on the history of the stupa, and as his views rest on secondary sources, discussion of them at present would be fruitless. The same may be said about his theories of the origin of the Buddha image and Buddhist symbolism. These are still matters of controversy, as he admits, and at present more warmth than light prevails. He is to be commended on his sober attitude, and on avoiding so far as possible disputes which in the present state of feeling are not likely to receive a final answer.

E. J. Thomas.

COMPARATIVE VERTEBRATE ANATOMY

Comparative Vertebrate Anatomy

By Libbie Henrietta Hyman. Second edition. Pp. xx+544. (Chicago: University of Chicago Press; London: Cambridge University Press, 1942.) 3.50 dollars.

Those who teach zoology and know the labour of abstracting the works of living comparative anatomists in an effort to amend the mistakes and imperfections of current text-books will find in Miss Hyman's book an accurate presentation of modern facts and views. Since Wiedersheim and Kingsley wrote their text-books on comparative anatomy, so much has been added to knowledge that our generation can no longer accept wholly their evidence or their opinions. What Miss Hyman has attempted is a comprehensive study of *research treatises* in order that she can dispense with dogmatic assertions and present the subject as a living, moving science, "to give the student a picture of a vast field full of controversial issues and unsolved problems, depending for their solution on future painstaking embryological and anatomical researches". We are wholeheartedly in sympathy with her aims, and congratulate her on the success that has crowned her efforts. She has demonstrated to the zoological world that despite present trends and fashions, morphology is not 'played out', as some would have us believe, but is still the foundation of zoology, which the physiologist, the experimentalist and all other sub-sections of the science cannot ignore.

The book is the second edition of a twenty-year-old "Laboratory Manual for Comparative Vetebrate Anatomy", and combines theory and practical work, but always with the intention that the dissection should illustrate and assist in the interpretation of the text. Although the comparative method is followed in dealing with organs and systems, it is realized that the animal as a whole must be studied, and the first five chapters are devoted to the anatomy and development of types. The remaining nine chapters deal with the skin and exoskeleton, the endoskeleton, the muscular system, the cœlom, the digestive, respiratory, circulatory, urogenital and nervous systems. A comparative study of the cœlom is welcome, and also the section on that most neglected subject, the muscles. Each system is traced from its embryonic beginnings through its changes in the vertebrate groups to the mammals. Practical directions, written up from actual dissections, are given, chiefly from the dogfish, skate, Necturus, turtle, pigeon, cat and rabbit. All technical words are defined when first used. Each chapter is provided with a summary and a list of references for further reading. An appendix lists technical terms, giving their origin and pronunciation. There is also a section dealing with the killing, preparation, injection and preservation of the material.

The illustrations are clear, simple and mainly schematic, and no detailed figures of dissections are given, as the author wishes the student to examine the specimens for himself. Labelling by using the full name of the parts delineated is a great improvement on the old method of using letters or abbreviations. On the whole, the number of illustrations is somewhat meagre and their quality disappointing. This is particularly so in the section dealing with the endoskeleton. From the land of W. K. Gregory we expect more interesting text and diagrams than are here presented. Even so, the author apologizes for treating "the skeleton . . . at greater length than is commonly the case", and she realizes "the importance of this system in the study of phylogenetic and evolutionary questions". A few good diagrams, for example, illustrating the anapsid, diapsid and synapsid conditions in reptiles and their modifications in mammals, the evolution of the complete hyobranchial apparatus, or of the changes in the carpus and tarsus in different groups, would be helpful.

In her choice of animals to illustrate evolutionary sequences the author is guided by the customs of American universities, but the British reader will be surprised to find Balanoglossus relegated to the Invertebrates, and very little mention made of the Osteicthyes, except for the ganoid fishes. On the other hand, Latimeria and Polypterus are in their proper setting, and the orders of mammals have been expanded in consonance with modern views of their relationships. Due regard is given to the divergent opinions of specialists, and the sections are logically presented. Very few criticisms of the subject matter are necessary, but *branches* of the precaval and postcaval veins, homologous *to*, and *plexi* are unfortunate in an otherwise scholarly work. Also is not *transverse bone* a more convenient name for a bone that is sometimes ectopterygoid and sometimes transpalatine ?

The book ends abruptly after the chapter on the nervous system. A chapter correlating the evolutionary history of the various systems is needed, since each system has become what it is to-day in virtue of its relation to other parts of the body. The evolution of the jaws, for example, is dependent on the evolution of the facial musculature, and on the modifications in tooth structure from homodont grippers to heterodont masticators. Or again, the vogue for size, complexity and multiplication of bony parts, which reaches its maximum in the reptiles, is followed by the welding together of loose units and the simplification and diminution in their number in the mammals. The purely comparative method has its dangers, because the student loses touch with the animal as a whole, and so fails to comprehend correlated trends in evolution.

The book is well printed and produced by the University of Chicago Press.

GENERAL ASTRONOMY IN SPANISH

El Firmamento

Por el Rev. Luis Rodés. Pp. xi+689. Segunda edición. (Barcelona and Buenos Aires: Salvat Editores, S.A., 1939.)

THE first edition of this standard Spanish textbook was published in 1927. It has now been brought up to date (1939), mainly by a considerable expansion of the sections on the external galaxies. No mention is made in the text of such recently discovered objects as Hermes or Jupiter X and XI, or (specifically) of the geophysical effects of chromospheric eruptions, but Pluto has a short section to itself.

The treatment followed in the first edition is preserved : the text contains a minimum of mathematics and a maximum of illustrations. These latter are on a scale which is unfamiliar to British eyes accustomed to war-time publishing standards ; in addition to the numerous explanatory diagrams, there are literally hundreds of magnificent plates, scores of them of full-page size, in half-tone, photogravure and colour. Perhaps the most striking feature, unusual in a book of this sort, is the section on the earth. This takes 150 pages to deal with its subject, and does it so thoroughly as almost to merit description as a popular treatise on climatology and meteorology in its own right. Striking parallels are drawn between the solar and terrestrial atmosphere by contrasting photographs of chromospheric prominences with pictures of terrestrial smoke, cloud and wave formations.

The author wisely makes no attempt to discuss the more advanced branches of the subject, where a mathematical approach can scarcely be avoided. The matters with which he does deal are treated authoritatively. The reviewer has noticed only minor slips, such as, for example, those on p. 147, where references to "Prof. Chapmann" and "Prof. Lindeman" testify, no doubt, to the difficulties of the Spanish compositor. The book may be recommended as an excellent popular account of astronomy. British readers who do not know Spanish but have a working acquaintance with French and an elementary grounding in astronomy should find no difficulty with the text, while the illustrations can be appreciated by anyone who has eyes to see.

Optics

The Technique of Definition. By Arthur Cox. Pp. 331. (London and New York: The Focal Press, Ltd., 1943.) 15*s*.

THE Focal Press is to be congratulated in having secured Mr. Cox as the author of this volume on camera lenses and allied optical equipment. The book gives a non-mathematical account of lens defects and describes the various lens combinations employed in photographic objectives to improve the definition and increase the aperture. Very useful information about the focus, angular field, aperture and type of lens has been tabulated and illustrated for a wide range of lenses produced by many different firms.

Several tables giving figures for depth of focus are included, but perhaps overmuch attention is given to this in view of its dependence on the nature of the subject being photographed and the extent to which the lens is corrected. There are also sections on methods of testing, the use of polarizing screens, colour filters and infra-red filters, and reference is also made to the reduction of reflexions at glass-air surfaces by the deposition of thin films on the surfaces.

Photographers should find the book of considerable value, enhanced as it is by many diagrams of an instructive and original character. The weakest part is the title. The book is neither a treatise on optics nor one on the technique of definition, but is a book on photographic optics; it is described as such, oddly enough, on the dust cover, but not in the book itself. However, it is the contents that matter, not the title. W. D. W.

An Introduction to Organic Chemistry

By Dr. J. W. Baker. (Dent's Modern Science Series.) Pp. vii+177. (London: J. M. Dent and Sons, Ltd., 1941.) 3*s*.

THE book provides an admirable general introduction to the subject and will commend itself both to student and teacher for its simplicity of approach. The latter is achieved by concentrating attention on the structure, reactions and inter-relationships of the more important groups which continually recur in organic compounds by a study of the simplest members containing them. This restriction of scope undoubtedly has great advantages, but it inevitably deprives organic chemistry of what is, to many students, one of its most attractive features, its association with naturally occurring compounds of biological significance. Excellent detailed accounts of some fifty-six experiments, illustrated with clear line drawings, are included at the end of each chapter.

Theoretical Organic Chemistry

By Dr. J. B. Cohen. Revised edition by Dr. P. C. Austin. Pp. xv+622. (London: Macmillan and Co., Ltd., 1942.) 10*s*.

THIS "entirely revised edition" retains many of the features which characterized the earlier editions. The rapid growth of organic chemistry, however, makes the task of the reviser ever more difficult, and although an earnest attempt has undoubtedly been made to bring this 'classic' up to date by the addition of new chapters, after forty years surely nothing less than complete re-writing and the provision of an entirely new set of diagrams can erase the inevitable signs of age. Much material of purely historical significance might have been sacrificed; petroleum as an illuminant is relatively unimportant compared with its value as a motor fuel. The latter topic receives far too little attention, an omission which is all the more serious in view of the growing importance of the petroleum industry as a source of basic organic chemicals such as olefines, butadiene, isopropyl alcohol and acetone. No mention is made of the direct production of nitroparaffins from hydrocarbons, and subjects such as plastics and catalytic hydrogenation are given inadequate treatment. Greater care might have been taken in ensuring accuracy, particularly in the new chapter on compounds of biological importance; xanthophyll is not an oxide of carotene, ergosterol has long been known to possess twenty-eight carbon atoms, and different molecular formulæ for cholesterol are given on different pages. E. R. H. JONES.

The Subject Index to Periodicals, 1941

Issued by the Library Association. Pp. x+204. (London: Library Association, 1943.) 77*s*.

THE Subject Index to Periodicals, 1941, issued by the Library Association, appears only some ten months after its predecessor, thus making up to some extent the loss of time incurred in 1940-41 and encouraging the hope that the Index can weather the storm without a gap in the sequence of its volumes or excessive delay in publication. This reduction of the time lag in publication is particularly welcome in some fields and should further enhance the value of the Index if it can be maintained or further reduced. The Continental periodicals previously indexed are no longer obtainable and their place has been taken by the following British and American publications, carefully selected by a sub-committee: *Anglo-Soviet Journal*; *Bulletin of the Friends' Historical Association*; *Bulletin of Spanish Studies*; *Comparative Literature Studies*; *Conveyancer*; *France Libre*; *Horizon*; *Modern Law Review*; *Music Review*; *Plastics*; *Religion in Education*; *Silk and Rayon*; *Soil Science*; *Transactions of the Leeds Philosophical and Literary Society*. As previously, the Index is compiled on the plan of the "dictionary catalogue", articles being entered under specific headings in alphabetical order. With some important exceptions periodicals covered by *Science Abstracts A* and *B*, the *Index Medicus*, *Agricultural Index*, *Engineering Abstracts* and *Index*, *Photographic Abstracts* and a few other specified publications are not indexed.

Textile Fibres under the X-Rays

By Dr. W. T. Astbury. Pp. 54. (London: Imperial Chemical Industries, Ltd., 1943.) n.p.

WE all know the remarkable progress made by Dr. Astbury in the X-ray study of textile fibres. What some of us do not realize, however, is the elegance of the structural relations underlying this new knowledge; many of them are enmeshed in a large and somewhat obscure body of literature. In this monograph (of which the publishers say that, owing to the paper restrictions, they cannot distribute copies freely in Great Britain) the essentials of the subject are presented with exceptional clarity, brevity and charm. It is just enough to whet any inquirer's appetite, and the well-produced plates add the appropriate garnish. All the X-ray photographs are of the original size, enabling the rotation formulæ illustrated in the first two figures to be applied directly. F. IAN G. RAWLINS.

DEVELOPMENT OF BOTANICAL INVESTIGATIONS AT ROTHAMSTED

AT the meeting of the Linnean Society on June 24, Sir John Russell and three of his staff outlined the history of the botanical work at Rothamsted Experimental Station since it was founded one hundred years ago.

In a rapid survey Sir John Russell showed how the association of Sir John Lawes—an essentially practical man—and Sir Henry Gilbert—a research worker with a genius for detail—led to the establishment of agricultural science on a firm basis in Great Britain. At the beginning the chemical aspect of crop growth was the only one considered, and much of the early work was determined by the controversy on the nitrogen nutrition of plants. Liebig emphasized, quite rightly, the value of mineral fertilizers, but maintained that the use of nitrogenous manures was unnecessary, as the plants obtained most of their nitrogen from the air. Lawes and Gilbert disagreed, and proved the value of nitrogenous fertilizers on the wheat plots on Broadbalk Field, obtaining striking increases in height and yield with progressively greater applications of ammonium sulphate. The problem of the source of the nitrogenous compounds in the soil was worked on by Prof. Robert Warington who, though primarily a chemist, diagnosed the activity of two forms of soil organism, one of which converted ammonia into nitrite, and the other transformed the nitrite into nitrate, thus completing the work of nitrification. He was not, however, able to isolate the two forms of bacteria concerned.

From 1856 onwards the botanical side began to emerge, primarily from studies of changes in the herbage of grassland induced by differences in manuring when the same treatment was continued year after year. Also, close observation was kept on the weeds in the arable crops, showing differences related to the varied manuring. Until the death of the founders in 1901 the botanical side retained this status of purely observational work on the fields.

With the coming of Sir Daniel Hall as director, the laboratory side of the work began to extend. There was a fuller recognition that plants are living things and therefore no two are quite alike, either in their form, development or response to similar conditions of nutrition or environment. Also it was recognized that no two areas of soil in the same field are absolutely identical, and that consequently it is not possible to adopt the same technique in dealing with plants as with chemical substances with their fixed reaction to any particular set of conditions. The recognition of these basal facts led to the gradual development of various departments concerned with different aspects of agricultural science. On the physical side it was realized that soil is not simply a supplier of food, but is a source of water and also provides a definite environment, specially in connexion with the supply of air to the roots of plants. Statistical methods were applied by Prof. R. A. Fisher to the lay-out of plot experiments, whereby smaller areas could be utilized, more treatments dealt with in a single experiment, and more accurate results obtained. On the bacteriological side the effects of partial sterilization on the soil microflora were worked out and, more recently, practical methods have been developed for inoculating lucerne seed with the appropriate nodule organisms.

In the earlier days attention had been focused on the importance of the 'major' elements, as nitrogen, potassium and phosphorus, in plant nutrition. Since 1906 the relation between 'minor' elements and plant growth has been under continuous consideration by Dr. W. E. Brenchley and her colleagues. The term 'minor' element is used to indicate those elements of which extremely small amounts are sufficient to influence the plant, either beneficially or harmfully. It in no sense indicates that these elements are minor in importance. In fact biologists and agriculturists alike are becoming alive to the fact that these elements are of the greatest importance in the metabolism of the plant, and in this connexion they are attracting attention much as vitamins have done in the economy of animal life. The complex chemical composition of soil renders it a very difficult medium on which to test the effect of minor elements on plants, as no real control can be exercised on the elements available to the roots. Such control is afforded by the nutrient solution method, and all the initial research has been carried out in this way.

Attention was first directed to a group of five minor elements already associated with plant growth in one way or another—copper, manganese, zinc, arsenic and boron, tested over a wide range of concentrations. Toxicity was easily shown—copper and arsenic being about ten times more deadly in the stronger concentrations than any of the others, manganese and boron being required in relatively large amounts to be lethal. Further work with copper, nickel and cobalt showed the varying response of individuals to concentrations on the border line of toxicity. In the presence of solid particles such as quartz, sand, or soil the poisonous action is greatly reduced. Consequently, plants growing in soil may be able to make normal growth in the presence of an amount of a poisonous substance which would kill, or at least seriously damage, a similar plant in nutrient solution.

Stimulation with minute traces of elements was far more difficult to demonstrate, though some indication was obtained. Following up an accidental clue obtained in 1921, Dr. K. Warington proved conclusively that in the absence of a trace of boron, growth of broad beans was completely checked, owing to atrophy of the meristematic points and subsequent breakdown of the tissues. The growing points of stems and roots, the flower buds and also the meristematic tissues of the nodules on the roots are all affected. Many other plants were also shown to require a trace of boron, and the work and literature on the subject has become very extensive. Various obscure plant diseases, hitherto classed vaguely as 'physiological', are now known to be due to boron deficiency. Heart rot of sugar beet, raan of turnips, topsiekte of tobacco, and other crop diseases are curable or prevented by the addition of about 12–20 lb. per acre of borax.

The fertilizer Chilean nitrate contains a number of minor elements, of which boron and iodine are the most prominent. The quantity of boron is adequate for the needs of plants, but so far it has not been possible to demonstrate any agricultural value of the iodine, though it is still possible that the feeding value of the crops may be improved by the absorbed iodine. Molybdenum is also present, and claims have been made elsewhere that it is essential for tomatoes. The results so far obtained at Rothamsted have been variable, though it is possible that molybdenum may hasten the ripening of tomatoes.

The more work that is done on minor elements the more complex the problem becomes. The cumulative evidence seems to suggest that deficiency symptoms are not always entirely the result of an inadequate supply of some critical element, but may also be bound up with other factors at present not fully recognized. Future work will doubtless have to be concerned with these factors as well as with the direct influence of minor elements on plant growth.

The recent bacteriological work at Rothamsted under Dr. H. G. Thornton has largely been related to the nodules produced on leguminous plants. It is well known that these nodule-forming bacteria fall into groups that are in general specific to certain groups of species or genera among their host plants. The bacteria are further subdivided into strains within each host-specific group. If a number of bacterial cultures are isolated from nodules on a single host species, they are found to vary very much in the benefit they confer on their host plant through nitrogen fixation. At one end of the range there are often to be found strains that are largely ineffective in this respect—scarcely increasing the nitrogen content of their host plant. Such ineffective strains are particularly noticeable among the nodule bacteria of clover and of peas and beans. A survey is now being made of the distribution of ineffective clover nodule bacteria in Great Britain. These are found to be particularly abundant in the poor sheep pastures of hill districts in Wales, the north of England and Scotland. The study of these strains has the improvement of the clover growth in such pastures as its ultimate object.

Anatomical study of the nodules produced by ineffective strains shows that these have a much smaller content of infected tissue than do effective nodules. In addition, the tissue disintegration and dissolution of the contained bacteria, which eventually occur in all nodules, take place much earlier in those produced by ineffective strains. If these factors are taken into consideration the amount of nitrogen fixed by a unit volume of bacterial tissue in a given time is the same for 'effective' and 'ineffective' strains. The latter are ineffective because they do not grow so well or last so long in the nodule as do the effective strains. It has been found that individual plants vary greatly in their response to the nodule bacteria. In a few plants, bacteria belonging to a normally ineffective strain can produce nodules of normal size and can benefit the plant. The converse can happen with a normally effective strain of the bacteria. There is some evidence that this variation in the response of the host legume is hereditary. If this is confirmed, it raises the hope that varieties of clover can be developed giving an effective response to infection even by a normally ineffective bacterial strain.

It may also be possible to mitigate the effects of a population of ineffective strains of nodule bacteria in the soil by supplying effective strains through seed 'inoculation'. Here, however, a difficulty arises owing to the acute competition that takes place in the root surroundings between different strains of nodule bacteria. Strains that compete successfully with others are those having a high initial multiplication rate in the soil. Strains have now been found that combine this high multiplication-rate with effectiveness towards their host plant. Such strains can compete successfully with ineffective strains in the soil and should thus be useful for the purpose of 'inoculation'.

Mr. F. C. Bawden proceeded to describe the investigations that have been made into the precise nature of those mysterious entities known as viruses. Viruses can conveniently be defined as obligately parasitic pathogens, too small to be resolved by ordinary microscopical methods. Their scientific study dates back to 1892 when Iwanowski, a Russian botanist, demonstrated that tobacco mosaic is a virus disease.

During the next forty years the number of recognized virus diseases increased steadily, and considerable progress was made in symptomatology and in discovering the means whereby viruses are transmitted, but little or no information was gained about their nature. They were generally believed to be the smallest living organisms, essentially similar to bacteria, though with the unfortunate properties of being invisible and unable to grow in culture media. During the last seven years, however, specific proteins have been isolated from plants infected separately with several different viruses, and all the available information suggests that these proteins are the viruses themselves. The size of the protein particles varies with different viruses, but all so far examined have particles with weights equivalent to molecular weights in excess of a million.

Tobacco mosaic virus was the first to be isolated, and is now recognized as a liquid crystalline nucleoprotein, in which X-ray diffraction has revealed a regularity of structure previously unsuspected in solutions. The greatly elongated particles found in a purified preparation of tobacco mosaic virus may be, in part at least, an artefact produced during the course of purification.

Other viruses, isolated from tomato, cucumber, potato and Hyoscyamus show similar optical phenomena, but tomato bushy stunt virus differs in that the solutions show no unusual optical properties, but when precipitated isotropic dodecahedral crystals are formed.

Most viruses spread readily from the point of entry throughout the infected plants to give a systematic infection, but in tobacco necrosis the symptoms are restricted to necrotic lesions on the inoculated leaves. Several different viruses and virus strains can cause the symptoms of tobacco necrosis, but on purification they precipitate in various ways.

All viruses so far purified have widely different properties and stabilities and are transmitted in different ways, but all are chemically similar nucleoproteins only varying significantly in their phosphorus and carbohydrate content.

X-ray analyses have shown that the viruses are in a sense double crystalline, and that the virus particles, even when in solution, do not contain any water. It is their chemical simplicity, the regular arrangement of their constituent units and their inability to take up water, that most sharply separates viruses from even the simplest known organisms. The intracellular inclusions so characteristic of many virus diseases may prove to be insoluble complexes formed by the virus combining with some constituent of the infected host plant.

The papers were followed by a short discussion, opened by Dr. B. Dyer, who recalled his first meeting with Lawes and Gilbert in 1865, beginning an association with Rothamsted which has lasted to the present day.

THE OPERATIONAL CALCULUS

By PROF. H. T. H. PIAGGIO

AT the thirtieth meeting of the Indian Science Congress, held at Calcutta during January 2–4, Dr. S. C. Dhar, president of the Section of Mathematics and Statistics, discussed certain developments of mathematics in the last thirty years. Mathematical research is now so varied that it is difficult for an active worker in one branch to follow progress in other branches. It is, therefore, very valuable when a specialist can give an intelligible summary of the chief results obtained in some particular subject. Dr. Dhar selected "Operational Calculus and Automorphic Functions". In what appears below, Dr. Dhar's address has been supplemented by matter obtained from other sources.

The operational calculus is associated particularly with the names of Oliver Heaviside ("Electromagnetic Theory", 1893, 1899, and 1912), T. J. I'A. Bromwich, and J. R. Carson. Heaviside's object was to solve certain problems concerning electrical circuits, which led to a set of differential equations. Self-taught and working in isolation, he not only took no trouble to conform with recognized mathematical methods, but even seemed to take a delight in apparently unsound arguments. "Mathematics," he said, "is of two kinds, Rigorous and Physical. The former is Narrow: the latter Bold and Broad. To have to stop to formulate rigorous demonstrations would put a stop to most physico-mathematical enquiries. Am I to refuse to eat because I do not fully understand the mechanism of digestion ?"

This attitude aroused great opposition from the pure mathematicians. But there was something to be said on their side. (Heaviside himself said, "even Cambridge mathematicians deserve justice".) Ever since the introduction of the differential calculus, mathematicians had been tempted to rely on intuition rather than on rigid proof. By this means they obtained speedily a large number of results, but unfortunately many of these were not altogether accurate. The error generally consisted of the assertion as a universal truth of a theorem which actually held good only in certain conditions. Only in the later part of the nineteenth century had Weierstrass and Dedekind succeeded in abolishing the slipshod methods of the preceding two hundred years, and in returning to the high ideals of mathematical rigour held by the ancient Greeks. To those who took part in this reform, Heaviside's methods seemed a kind of mathematical blasphemy, a wilful sinning against the light. Yet Heaviside's results were always correct! Could a tree be really corrupt if it always brought forth good fruit ?

It may be recalled that a similar situation arose early in the nineteenth century. Fourier expanded functions in an infinite series of harmonic terms, and applied the results to problems in the conduction of heat. The results were very valuable, and yet the methods by which they were obtained were unsound, as was pointed out at the time by Lagrange. The investigation of the reason for the success of Fourier's work was very difficult, but it ultimately led to great advances, and may be taken as the starting-point of the theory of functions of a real variable. Possibly with this in mind, pure mathematicians of the twentieth century, when the battle for rigour had been won and the victors could afford to take up a more tolerant attitude, began to show more appreciation of the "Bold and Broad". Prof. G. H. Hardy, some time before 1914, expressed the view that what analysis then needed was a twentieth century Euler, capable of trying daring experiments with what one might call "conjuring tricks in mathematics"; the details of justification might then be filled in by workers at their leisure.

However, the task of justifying Heaviside's methods proved unexpectedly difficult. His basic idea was to treat the differential operator p as an algebraical symbol, and to pass from a differential equation to a subsidiary algebraic equation which had the distinctive property of incorporating the initial conditions. The solution of this equation was resolved into partial fractions, or expanded in inverse powers of the operator, which were interpreted as integrations. Sometimes fractional powers of the operators occurred, and these were interpreted by a rule which was a natural generalization of that for integral powers. Unfortunately, as the work proceeded, more and more apparently arbitrary rules were needed to reach the correct result. Dr. Bromwich was the first to give any rational explanation of these rules, but he found it necessary to adopt an entirely different approach, namely, the use of complex variables and contour integrals, a method first used for differential equations by Cauchy. A German, K. W. Wagner, independently studied the problem at the same time (1916) and obtained some of Bromwich's results. Since then operational methods have been generally accepted, although there is still some doubt concerning their application to partial differential equations. Bromwich considered that Heaviside must be ranked with the greatest constructive mathematicians of the nineteenth century, far outstripping the finest senior wranglers of the Mathematical Tripos in his amazing skill in manipulation.

Another justification of Heaviside's work was given in 1917 by an American, J. R. Carson, using only the real variable. By means of the equation

$$\phi(p) = p \int_0^\infty e^{-pt} f(t)\, dt,$$

he set up a correspondence between $f(t)$, a given function of the time, and its operational representation or symbolic image $\phi(p)$. From this Carson derived a set of theorems of the utmost importance in operational calculus and in the solution of electrical problems. Further developments are due to many writers, in particular Van der Pol (from 1929). A recent book is Carslaw and Jaeger's "Operational Methods in Applied Mathematics" (1941). Besides the primary application to differential equations, operational methods give a simple method of obtaining relations between functions by finding the much simpler relations which often hold between the symbolic images and then transforming the results.

Dr. Dhar also dealt, but more briefly, with automorphic functions, which may be defined as functions which remain invariant when subjected to a group of bilinear transformations. Automorphic functions are a generalization of trigonometric functions, which are periodic, and of elliptic functions, which are doubly periodic. The pioneer work was due to Poincaré (1881) and Klein (1882). Recent advances have been due to E. T. Whittaker and his pupils.

PRESERVATION OF MUSEUM OBJECTS IN WAR-TIME*

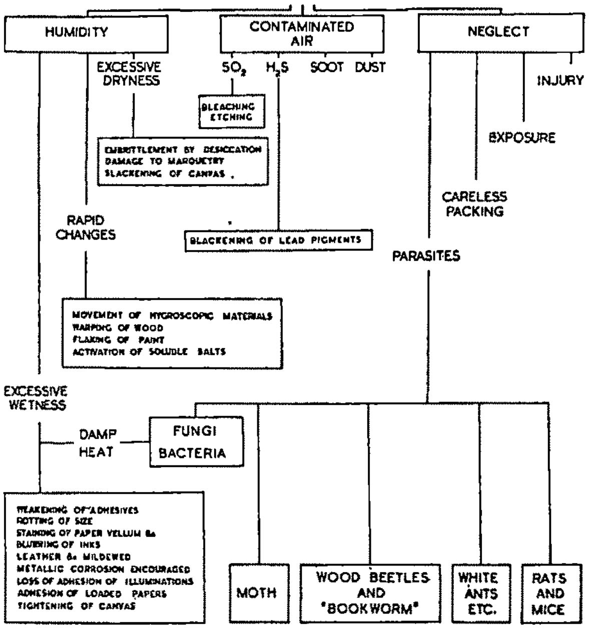
By DR. H. J. PLENDERLEITH

Research Laboratory, British Museum

THE care of the national treasures in museums and galleries is a very great responsibility at any time, but particularly so in war-time. Whatever the nature and size of the collection, modern warfare presents the curator with a two-fold problem, involving, first of all, measures to circumvent the immediate disaster of bombing and, secondly, measures to prevent the gradual deterioration which is so often the accompaniment of prolonged storage.

Early in the War of 1914–18, as the staffs of museums became depleted, it seemed likely that museum specimens might suffer more from the lack of expert attention than from high explosives, aerial warfare being at this time in its infancy. But in the summer of 1915 the first bombs fell in London. Sir Frederick Kenyon[1], who was then director of the British Museum, has described the Herculean task that had to be faced in evacuating a large proportion of the collections to a new Post Office section of the London underground tube railway system, which had been hurriedly prepared to receive them and where they were to remain for almost two years. It seemed that little damage resulted from this double removal, but nevertheless in 1919 the Trustees thought it advisable to invite the Department of Scientific and Industrial Research to make a scientific examination of the collections and give advice and assistance in regard to the restoration and preservation of objects. Dr. Alexander Scott undertook this investigation on behalf of the Department; a small temporary laboratory was equipped at the British Museum and a considerable amount of introductory experimental work carried out, the practical applications of which were embodied in three reports[2], which had a wide circulation.

CAUSES OF DAMAGE TO MUSEUM OBJECTS



Dr. Scott's method was to study the causes and symptoms of instability and to work out methods of treatment which "could be regarded as safe if applied with ordinary care and discretion". There were to be no secret processes. Help was to be freely afforded to all who had the care of precious objects of antiquity and works of art. It was thus possible to obtain a wide experience in dealing with museum objects and materials of all kinds and to obtain an insight into the technical requirements of museums and picture galleries. This was essential because stability is, after all, a relative term and conservation only begins to have practical significance when the conditions under which things are to be conserved are clearly defined.

The new outlook was welcomed almost universally in the museum world at home and abroad. The traditional distrust of science gradually disappeared and with it many outworn conventions of technique which had proved to be stumbling-blocks to progress. There was active support in Great Britain from the Museums Association[3]. The next few years were marked by the extension of the laboratory idea abroad, and the League of Nations[4] organized a series of conferences for the special study of problems affecting the preservation of works of art and of antiquities. Individual workers made valuable contributions, and specialized laboratories (notably the Fogg Art Museum Laboratory[5], Cambridge, Mass., and National Gallery Laboratory, London) did much to enrich the common fund of technical knowledge which was ready to hand and had merely to be mobilized and assorted in preparation for a second world war.

Early in 1939, at the instance of the Standing Commission for Museums and Galleries, a committee was convened representing the national museums, picture galleries and libraries under the chairmanship of the director of the British Museum, Sir John Forsdyke. This committee considered at great length many aspects of the preservation of museum objects in war-time, and the findings were incorporated in a handbook entitled "A.R.P. in Museums, . . ."[6]. This booklet was timely in its appearance and of great service in helping curators all over the country to mature plans for the protection of their collections in advance of the approaching catastrophe of the autumn.

It is no easy matter to make adequate preparations for the safety of a collection of museum objects, because there are so many divergencies of type. There are endless variations of material, structure, age and stability. Some objects are by nature perishable; others become so from a variety of causes. Before it is possible to work out satisfactory methods of protection, the relative frailty of objects must be studied, the symptoms of decay recognized, and some knowledge is also required of the varying conditions under which deterioration is aggravated or arrested—precisely the line of research inaugurated by Dr. Scott at the British Museum twenty years previously.

The main causes of decay are fortunately few in number and can be conveniently summarized (see accompanying table). It may be stated on simplest analysis that decay arises either from internal causes (for example, the presence of crystalline salts in the pores of stone) or from causes which are external (such as excessive humidity in storage rooms), and when decay is already taking place from internal causes, exposure to heat and moisture has usually the effect of accelerating the action and intensifying the damage.

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* Substance of Friday evening discourse at the Royal Institution on May 21.

Damp promotes the mildewing of books and papers with consequent staining and disintegration. It also promotes the corrosion of metal objects. Leather is very susceptible to attack by moulds, which grow most actively in damp surroundings. Uncontrolled changes of humidity and temperature are most destructive to paintings whether on canvas or on panel, causing cracking and blistering of the paint, and for this reason pictures are as a class among the most delicate of museum objects. These considerations have all to be taken into account in arranging for packing and transport, and in deciding upon suitable storage accommodation.

Fortunately there remains a large category of objects which are resistant to damp and impervious to atmospheric changes. Such things as porcelain, baked clay, most kinds of glass, many metals, stone monuments free from salts, natural history specimens in spirit, etc., and these (with any packing that may be necessary) may be consigned to the cellars with a fair prospect that they will not suffer deterioration by neglect.

It will be obvious from the preceding statements that any storage space which affords safe protection from the effects of bombing can always be utilized; if the temperature and humidity can be controlled at reasonable levels its value will be infinitely greater, and if constant atmospheric conditions are obtainable in the right degree it will satisfy the exacting requirements of a permanent repository for the most delicate material.

Looking back over the years of peace, two further lines of investigation stand out as of the first importance to the preservation of museum objects in wartime. These are Macintyre's work on atmospheric humidity and Groom and Panisset's studies on the growth of micro-organisms.

In 1929 Mr. J. Macintyre[7] (late of H.M. Office of Works) took hygrometric readings over a period of time (*a*) in the open air, (*b*) in a museum gallery and (*c*) in an exhibition cabinet within the gallery. This cabinet contained only some hygroscopic material (canvas). He found that the variations in relative humidity (R.H.) were much less extreme in the gallery than outside the building, and that within the cabinet no maxima and minima of humidity were recorded. The relative humidity in the cabinet had remained to all intents and purposes constant. The work was confirmed by further tests made at the British Museum by placing recording instruments in an exhibition case of considerable capacity (176 cub. ft.) which was not even provided with an air-tight door. The case had 88 sq. ft. of glass and the equivalent of textile lining. It was found after the short interval of time which was necessary to establish equilibrium that the hygrograph pen became almost stationary and a horizontal line was drawn across the chart.

Certain deductions may be drawn from this, which have a direct bearing on the packing of museum objects which are sensitive to damp.

(1) The presence of soft hygroscopic packing materials, such as cotton-wool, kapok, wood-wool and paper are beneficial in the steadying effect they have upon humidity within the box. Objects should be wrapped in tissue and nested in the soft packing. Such packing materials must obviously be dry, otherwise humidity will be stabilized in the box at a high level.

(2) It would be very unwise to open a box for inspection purposes when external atmospheric conditions are unsatisfactory, as this would allow access of moist air which would remain and encourage mildew growths.

Packing is very largely a matter of common sense. Special methods are required with machinery, heavy sculpture, paintings and large intricate objects. These should be anchored by struts of wood fixed inside the packing case, the final fitting being often a wedge-shaped piece of hard-wood screwed in position inside. When heavy objects are stored for any length of time, the elasticity of the packing materials may be impaired, so that specimens settle lower in the box and become loose. When this happens repacking is required before it is safe to contemplate transport.

Turning now to the question of storage, it may be asked whether it is possible to define atmospheric conditions which are entirely safe for all kinds of museum objects. In order to answer this we turn to an investigation conducted by the late Prof. P. Groom and Miss T. Panisset[8] in 1933 on the mildewing of binding materials. Of all the materials studied tanned skins were found to be the most susceptible to fungoid growth. Efforts were made to grow mildew on these over a wide range of humidity and temperature, and the lowest relative humidity at which growths were observed with the naked eye was 72·6 per cent, the corresponding temperatures (68–77° F.) being near the optimum. Twenty-four weeks actually elapsed between the first of a series of inoculations with young conidia and the appearance of growths. There seems justification, therefore, for regarding a round figure of 70 per cent R.H. as the upper limit beyond which the atmospheric humidity must not be allowed to rise (irrespective of temperature) if mildew growths are to be avoided. In point of fact, the constant conditions recommended for paintings are 60 per cent R.H. at 60° F., and while these conditions would of course be ideal for collections of any kind, variations of 5° and 5 per cent either way would not be deleterious in museum and library repositories. Where any doubt exists, tests of the humidity are readily made by the use of a whirling psychrometer, and it is important to take such observations at regular intervals in basements and strong-rooms, continuing at least until such time as it is evident that conditions are likely to remain satisfactory. If damp is excessive, measures are taken to improve ventilation, for example, by piercing walls and doors, using electric fans and heaters or the more efficient shelter heating units. For certain museum objects and paintings damp is disastrous, but excessive changes of humidity may be even more damaging. A temporary cure for varying humidity is to cut off completely all external ventilation and to condition the air in the room by heaters and fans[9]. This has the effect (*a*) of stabilizing the relative humidity and (*b*) of reducing it to the required degree at a temperature which is fairly constant, but the scheme can only be considered safe when under constant observation and psychrometric control. It is an emergency method, easily arranged at short notice where there is a suitable electric supply, but entirely dependent for success upon the human factor.

The main problem in basement storage is to avoid pockets of cool stagnant air, and skill is required in the

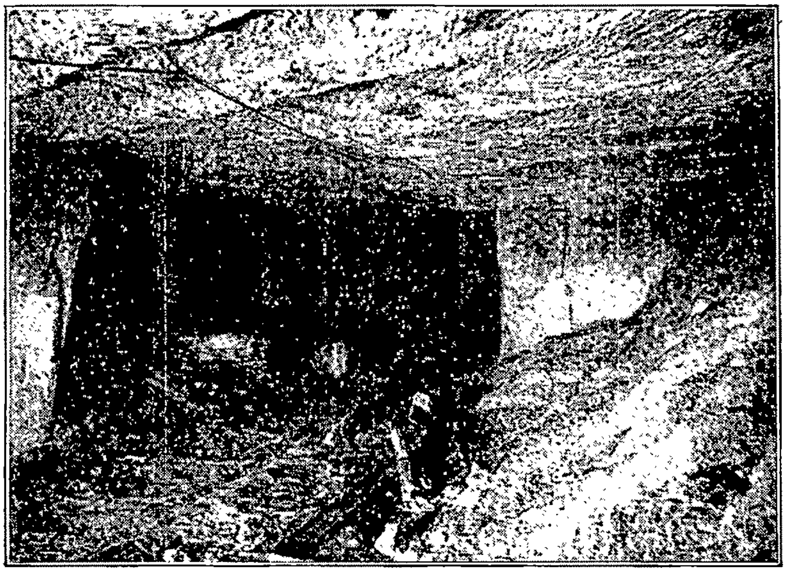

Fig. 1.

stacking of boxes and the fitting of any wooden racking that may be necessary. Boxes should always be raised on duckboarding or battens so that they are not in contact with the floor, and a free air space should be left next the walls. This provision is essential for safe storage in normal times, but in time of war when there is a possibility of flooding from hydrants or burst pipes, the question of drainage has to be taken into account in determining the height of wooden staging.

When book-racking is built adjacent to an outside wall, provision of several inches of air space at the back is very important. Openwork racking and shelving is safer than cupboard storage. Books should never be stored for any length of time in heaps even in a dry room because of their proneness to mildew and 'foxing'. There may be no option in an emergency, but any such arrangement should be of temporary duration.

Circumstances are different in the case of objects which are impervious to damp. Here it will be a question of preserving the labels by wax; they should be of the 'tie-on type and should be clearly written with a black waterproof ink. Organic packing materials are so far as possible excluded, and wooden boxes may be lined internally with waterproof paper and painted on the outside with 10 per cent copper naphthenate in paraffin oil, in order to minimize the tendency of the wood to rot.

Much ingenuity has been expended in designing special containers suited to various classes of material. For conditions which are reasonably dry, the plywood no-nail box has much in its favour. Where damp has to be feared, small air-tight galvanized metal containers have been employed for storing manuscripts. The manuscript is placed in the box, the air within being of the degree of dryness suitable for permanent preservation of the contents at the temperature of the storeroom, and the jointing is then made air-tight with a strip of soft solder. The curator of the Reading Museum has solved the problem of storing his collection of vellum documents by placing them in a couple of hundred dust-bins, each with a tar felt lid pressed over, and then the metal lid is pressed on and lashed firmly to the handles. Within each bin is a tin of dry silica gel inserted before the container is closed, and this absorbs excess moisture from the air. Access to the documents is occasionally necessary and a fresh tin of silica gel is then inserted before replacing the cover. Excellent reports have been received of the efficiency of the arrangement.

With the widespread development of aerial bombing it was increasingly obvious that no surface shelter could be regarded as safe. The London 'Underground' provided a partial solution for some museums; others, having objects that could withstand damp, took to deep tunnels in the chalk.

An early experiment in artificial tunnelling in a hillside in the country proved more costly than anticipated, but satisfactory housing was eventually obtained there for books, prints, drawings and manuscripts. To control the humidity within the desired limits, the intake ventilation duct was equipped with fans and a battery of electric heaters, and there was provision against the emergency of electrical breakdown by an independent auxiliary greenhouse heating equipment and manually operated fans.

When air is taken direct from outside, as in the above system, the control of humidity by heating may necessitate considerable variations of temperature, but when a bulk supply of saturated air is already available at a low constant temperature (a common

Fig. 2.

condition in certain caves and mines) it is possible to obtain the required humidity by raising the temperature to a fixed degree, and under favourable conditions this temperature may also approximate to requirements. Such a scheme has been applied successfully in certain disused underground workings. It involves the building of suitable chambers as repositories in the caverns underground, and these are each equipped with batteries of heaters and fans which pass the conditioned air into plenum systems within the repositories. This scheme lends itself particularly to the storage of paintings because of the area of dry wall space that the chambers afford, and the most striking example is no doubt to be found in the main National Gallery repository recently described by Mr. F. I. G. Rawlins[10].

When it is a case of storing valuable furniture, carpets, textiles, large quantities of irreplaceable books and manuscripts, antiquities and ethnographical objects of all kinds, the first essential is one of floor space, and to satisfy this requirement on an adequate scale, building and excavation are alike out of the question. For the cream of the collections of the British Museum and Victoria and Albert Museum, there was no option but to find sufficiently extensive underground workings in rock which could be waterproofed and in which the air could be fully conditioned as to temperature, humidity and ventilation. Nothing short of an undertaking of this magnitude could satisfy what had become, by the spring of 1941, an urgent requirement of great national importance. Before any valuables could be stored it would have to be demonstrated that conditions of 60° F. 60 per cent R.H. could be continuously maintained, and that there was adequate provision in the plant-room against the possibility of breakdowns. It was a question of perfection or nothing.

The choice of site presented many difficulties, as did the preparation of accommodation, but thanks to the Ministry of Works and Planning the ideal repository was brought into being within the remarkably short space of time of one year, and has since been used to capacity (Figs. 1 and 2).

The full value of the work which had been already accomplished in devising standard forms of package and racking was now apparent; uniform series of boxes made for economy in storage space, and distribution is such that it is possible to have immediate access to any specimen by consulting the location inventory. Carpets are tightly rolled and sealed up in paper and they are stored on staging covered with chicken-netting; most of the smaller textiles are suspended on coat-hangers on avenues of horizontal rods, the more fragile under 'Cellophane' envelopes. Fluorescent lighting is available in the inspection rooms and compressed air is laid on to facilitate insecticidal spraying, should moth be discovered.

A feature of the plant room, which is separated from the main repository by strong-room walls, is the arrangement made for the remote observation of conditions in the repository and for the remote control of machinery connected with the conditioning of the air. The engineer-in-charge has before him Cambridge recorders which show at a glance the conditions of temperature and relative humidity at various selected points in the store, and by operating the remote controls he can adjust the setting of the automatic switch gear, if for any reason it should be necessary to vary the air supply in quality or in volume.

It is no exaggeration to state that in every detail of storage there is indication of forethought and skilful planning, and that the directors of the British Museum and Victoria and Albert Museum, with the support of their respective staffs and the Ministry of Works and Planning, have jointly been able to contrive and bring into actuality a museum in the bowels of the earth, which, from the point of view of conservation, is as fine as anything known above ground, either in Great Britain or elsewhere. Much valuable experience has been gained and it is a comforting reflexion that this knowledge will be applied in the remodelling of our museums after the War, so that the national treasures can be adequately housed and suitably displayed.

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[10] Rawlins, F. I. G., NATURE, 151, 123 (1943).

OBITUARIES

Sir Thomas Middleton, K.C.I.E., K.B.E., C.B., F.R.S.

SIR THOMAS HUDSON MIDDLETON, chairman of the Agricultural Research Council and formerly professor of agriculture in the University of Cambridge, died at his home, Whyte House, Strawberry Vale, Twickenham, on May 14 at the age of eighty.

Sir Thomas was educated at Merchiston Castle School, Edinburgh, and at the Universities of Glasgow and Edinburgh. His first post (1889) was the professorship of agriculture at Baroda College, India. He held this until 1896, when he became lecturer in agriculture in the University College of Wales, Aberystwyth. Then, in 1899, he was appointed to the professorship of agriculture at Durham College of Science, and, in 1902, to the professorship of agriculture in the University of Cambridge. The Department of Agriculture, as it was then described, was a young one, inadequately staffed and housed, and struggling to find its place in a University which at that time looked upon applied science with almost as much suspicion as the farmers of the Eastern Counties of England. Agriculture in Britain had drifted into a pitiably depressed condition, and large areas of land were passing out of cultivation. To check the prevalent 'tumbling down' of good arable land to grass, he set in train a series of demonstrations in Cambridgeshire and the surrounding counties on the technique of laying down land to grass with appropriate seeds mixtures. He also instituted trials to determine which were the best varieties of potatoes for growing in the Eastern Counties and to demonstrate, among other things, the value of a 'change of seed'. This was particularly congenial work to him, for his home training on Rose Farm in the Black Isle, Cromarty, had provided him with an exceptionally thorough knowledge of the crop. These demonstrations soon proved to be of great value to the farmers of the Eastern Counties and went far to dispel their mistrust of everything connected with laboratories and experimental farms.

Middleton's stay in Cambridge was a short one, for in 1906 he accepted the post of assistant secretary of the Board of Agriculture. It is no secret that he had misgivings about the advisability of doing so, and his friends, realizing how much his interests were bound up with an open-air life, did their best to dissuade him from taking this step by pointing out that the Board, at this time, had only a somewhat tenuous interest in education, and no vision whatever of the part research work could play in the development of agriculture; but the view that he could do more for agriculture as a Government official than as a university professor won the day.

This post he held until 1919, acting during the last two years of his tenure as deputy director general of the Food Production Department. The campaign he then became responsible for, hurriedly planned as it inevitably was, added the produce of approximately an extra three million acres to the national food supply in spite of a great shortage of labour, fertilizers and machinery. The full story of it is told in his book "Food Production in War" (Oxford, 1923).

With the coming of peace in 1918, Middleton was appointed a commissioner under the Development and Road Improvements Funds Acts of 1909–10. He continued to serve the Development Commission until 1941, becoming its vice-chairman in 1929. His tenure of office was broken into in 1926–28, when his wide experience of agricultural administrative work and his knowledge of agriculture in India was put at the disposal of the Royal Commission on Agriculture in India.

In 1938 Middleton was appointed chairman of the Agricultural Research Council by a committee of the Privy Council for the Organization and Development of Agricultural Research, after consultation with the Royal Society. He was ideally fitted for guiding a Council consisting of scientific men with no special knowledge of agriculture, and agriculturists with an equally limited outlook so far as scientific matters were concerned, for his work had brought him into contact with the research staffs of practically all of the agricultural institutions in Great Britain, and he never missed an opportunity of discussing with them, no matter what the subject, the investigations they were engaged upon. A wide general knowledge of the more important of the sciences bearing on agriculture made this possible and put him in a position to see most of the problems of agricultural development, as the directors of research institutes have to, from both the scientific and practical points of view.

Of the honours which fell to Middleton, two were especially valued. One of these was the fellowship of the Royal Society, awarded in 1936; the other was the Gold Medal of the Royal Agricultural Society, given for distinguished services to agriculture. He was, fittingly, its first recipient. The Universities of Aberdeen, Edinburgh and Wales conferred the LL.D. and Reading the D.Sc. upon him. In 1913 he was made C.B.; the honour of K.B.E. came in 1918, and K.C.I.E. in 1929.

Endowed almost to the end of his life with the best of health and a fine physique, Middleton was capable of tiring out his staff and the visitors to his demonstration plots, and then returning to a strenuous evening's work in the laboratory or his home. But though he never seemed to allow himself any leisure, he found time for two hobbies: one was photography and wherever his work or his holidays took him he carried a camera; the other was gardening. In Cambridge, in somewhat difficult conditions, he maintained a first-rate collection of roses chosen, as they flowered in a local nursery, with the keen discrimination of an old-time florist and grown with the aid of combinations of the various artificial manures used in his farm demonstration plots.

He married Lydia Miller, daughter of the late Prof. Davidson of Adelaide; she died in 1934, leaving a son and a daughter.

ROWLAND H. BIFFEN.

Dr. Karl Landsteiner, For.Mem.R.S.

THE death of Dr. Karl Landsteiner on June 26 in New York has closed a career of singular eminence in the realm of medical research. He was born in Vienna on June 14, 1868; graduated in medicine in 1891 at the University there; and from 1909 until 1919 held the post of professor of pathologica anatomy in the University. After the War of 1914–18 he left Vienna to work in a hospital in The Hague and from 1922 until his death he carried out his researches as a member of the staff of the Rockefeller Institute in New York.

As a young investigator, Landsteiner was deeply interested in the problems of serology and immunology Together with Donath he made observations on the substance in organ extracts which lyses the strictly homologous red cells, and which he and his co-worker identified as Metchnikoff's macrocytase With Halban he studied the differences of fœta and maternal blood sera from the point of view of their lytic, agglutinating and bactericidal properties Donath and Landsteiner in 1904 and 1905 made a notable contribution to knowledge of the role of intravascular lysis in the pathogenesis of paroxysma hæmoglobinuria. But the chief work of Landsteiner at this early stage was the recognition of differences in human red blood corpuscles when obtained from different individuals, and the separation of the red cells into four well-defined groups characterized by their behaviour when exposed to the action of the two main types of agglutinins that are met with in human sera. A statement foreshadowing this work was made in a footnote to a paper on the anti-enzymic lytic and agglutinating action of blood serum and lymph, which is dated February 10, 1900. He was an assistant in the Institute of Pathology in the University of Vienna when, in 1901, he published his work on iso-agglutination and the blood groups. Even at this early date he was aware of the probable significance of his results for medico-legal purposes and in the practice of blood transfusion. The value of his pioneer researches on the subject was attested when, in 1930, he was awarded the Nobel Prize in Medicine.

The importance of this work has been abundantly proved during the present War in the avoidance of undesirable reactions by ensuring that the donor's blood is compatible with that of the recipient. In spite of every care, inexplicable reactions hav occasionally occurred, and it was Landsteiner and Wiener who threw light on these accidents when in 1940, they discovered a hitherto unsuspected antigen, the *Rh* factor, a symbol chosen because a similar antigen exists in the blood of rhesus monkeys This antigen is present in the red blood cells of 8 per cent of human subjects, and an importan extension of knowledge arising from its study ha een the elucidation of the cause of the hæmolytic næmia of newborn infants; this disease has been ound to be due to the production of a lysin in the lood of an *Rh*-negative mother when the fœtus has nherited the *Rh* factor from the father.

The first two papers by Landsteiner and E. Popper n the experimental transmission of poliomyelitis to nonkeys appeared in 1908 and 1909, and opened he way to intensive study of the mode of ransmission of the causal filterable virus and of its eutralization by a specific immune serum.

During the twenty years between 1917 and 1938, Landsteiner and his co-workers extended the observations of Obermayer and Pick on the changes in the immunological specificity of proteins which result from modifying their chemical and physical structure. This series of researches gave full rein to Landsteiner's creative and analytical powers; in particular, the ingenious experiments with artificially conjugated antigens and the corresponding immune sera have shed much light on the nature of the serological specificity of proteins and cell antigens.

The last years of his life were devoted to studies on allergic manifestations produced in experimental animals in response to simple chemical compounds such as picric acid and quinine.

The consistently high level of Landsteiner's achievements throughout the long period of his active life makes it natural to imagine that he knew little or nothing of the painful gropings after scientific truth which afflict lesser men. Although his work received recognition in many quarters—he was elected a foreign member of the Royal Society in 1941—he bore himself modestly, and indeed seemed to forget self-interest in his preoccupation with the problems upon which his mind was bent. His name is assured of a permanent place in the records of experimental medicine. G. F. PETRIE.

NEWS and VIEWS

The Wellcome Foundation: New Research Appointments

DR. C. M. WENYON will be retiring shortly under the age limit from the directorship-in-chief of the Wellcome Research Institution and the directorship of the Wellcome Bureau of Scientific Research. His association with the research laboratories founded by the late Sir Henry Wellcome has extended over thirty-six years, commencing at the Wellcome Tropical Research Laboratories in Khartoum in 1907. Among his many contributions to the literature of protozoology his "Protozoology—A Manual for Medical Men, Veterinarians and Zoologists" is outstanding. Dr. Charles H. Kellaway, at present director of the Walter and Eliza Hall Institute for Medical Research, Melbourne, has accepted the invitation of the Board of the Foundation to assume the directorship-in-chief of the Wellcome Research Institution and the Foundation's other research laboratories at home and overseas. His appointment will become effective as early in 1944 as the convenience of the governing body of the Hall Institute and transport arrangements from Australia will permit.

Dr. N. Hamilton Fairley will take over the directorship of the Wellcome Bureau of Scientific Research. However, as he is at present Colonel A.A.M.C. and is serving as director of medicine to the Australian Army in the Pacific, he will be unable to proceed to England until a later date. Dr. T. A. Henry will be retiring on August 31, after which the Wellcome Chemical Research Laboratories (London) will be merged in the Wellcome Bureau of Scientific Research referred to above. Dr. Henry's work in the field of plant alkaloids is well known, and his book, "The Plant Alkaloids", is regarded as a classic in this field. The laboratories under his direction have always specialized in the chemistry of tropical medical research and will continue to do so.

Dr. Erwin E. Nelson, at present director of pharmacology at Tulane University, New Orleans, has been appointed director of the Wellcome Research Laboratories at Tuckahoe, N.Y. Dr. Nelson, who graduated in medicine at the University of Michigan, was from 1919 until 1937 assistant professor, associate professor and then professor of pharmacology there. During that time he was lent to the U.S. Government for two years so that he might organize the Pharmacological Department of the Food and Drugs Administration. Plans are in view for the further development of the Wellcome Chemical Research Laboratories at Beckenham under Dr. Sydney Smith, and a considerable expansion of the Foundation's research activities is envisaged for the immediate post-war period. Various changes in the organization of the Laboratories will be made in order that the Foundation's own research plans, as well as those carried on in collaboration with Government Departments, the Therapeutic Research Corporation and other bodies, may be fully realized.

A Staff College for the Civil Service

IN NATURE of May 8 was published a leading article which raised what we regarded, and still regard, as pertinent questions for the committee appointed by the Chancellor of the Exchequer to examine the matter of the training of Civil servants. We pointed to the committee's terms of reference and asked why the possibility of establishing a staff college should have been given special prominence, and we went on to give our views as to why a staff college, *if it be the only means of entry into the service*, may have precisely the results which ought, at all costs, to be avoided. Nothing in what we said, however, decried or was intended to decry the value of a staff college if it be given its proper place in any scheme for the preparation of future administrators. Our point was that such a college should not be allowed to take the place of the universities, the technical colleges and the other educational institutions in which candidates for the Civil Service may gain their first qualifications. We hope, however, that the committee to which we have referred will study carefully a paper on the "Post-Entry Training for Administration from the Industrial Aspect" recently delivered to a conference of the Institute of Public Administration by Mr. E. S. Byng, vice-chairman of Standard Telephones and Cables, Ltd.

Mr. Byng not only traced the growth of the need for training in administration selected members of staffs and the encouragement given towards that end by professional institutions: he also pointed out quite clearly that in the staff college he visualized, the curriculum would be concerned with broad administrative problems, and would exclude subjects covered by ordinary training.

A National Administrative Staff College

MR. BYNG made it clear, too, that the outstanding feature of the scheme of a national administrative staff college was that it would be highly selective. No matter in what department—accounting, commercial, engineering and the like—candidates for admission had served, only those who had shown themselves likely to qualify for higher grades of administrative responsibility would be considered. Moreover, while the course would extend over five months, not more than one quarter of the time would be devoted to formal instruction. The remainder would be occupied by discussions, practical exercises directed to testing powers of exposition, of investigating problems, drawing up reports and so on. Already, Mr. Byng told his audience, the group responsible for this proposal claim that among some two hundred and fifty people who have been consulted (and they include members of the Government, both Houses of Parliament, representatives of the Civil Service, local government, industry and the universities) all but a few have expressed their approval. We are glad to note these opinions from varied sides of our national life because they reinforce another of the points made by Mr. Byng. It is that industrialists and business men are ready, if not anxious, for an all-inclusive staff college. They would welcome the idea that picked men from the Civil Service should study together with picked men from their own ranks. We believe there is much to commend the idea. The growth of large-scale organizations, and of quasi-public corporations controlling services previously rendered by private enterprise, have made the differences between business and the public services much less definite than they used to be. Indeed, the relations between the business world and the Government departments become more and more intimate and complex. The War has added strength to that tendency and there would be obvious advantages in bringing together what Mr. Byng calls "the future administrators of both worlds" during a critical part of their training.

Post-War Demobilization of Scientific and other Personnel

A DEFINITE step in preparation for the demobilization of scientific, technical and professional staff from the Services and from the war industries at the end of hostilities and for their redistribution in suitable occupations both at home and overseas has now been taken by the Minister of Labour and National Service in the appointment of a Committee of Inquiry, with Lord Hankey as chairman. The Committee includes Mr. J. S. Duncan, Deputy High Commissioner for Australia, and the Dominions of Canada, New Zealand and South Africa will be represented by observers. The terms of reference are: To consider and report upon the arrangements which should be made to facilitate the employment after the end of hostilities of men and women qualified to undertake responsible work in the professions o elsewhere, with particular reference to (*a*) th organization, premises and staff of the Appointment Department of the Ministry of Labour and National Service; and (*b*) the arrangements which should be made for co-operation between the Appointments Department and other organizations and institutions (including professional, industrial and commercia organizations) and universities, at home and abroad In addition to those named above, the Committee includes Mr. H. M. Barton, Sir Bernard Bowdillon Mr. J. T. Davis, Mr. R. H. Dobson, Sir William Fyfe Mrs. Mary Hamilton, Mr. Clement Jones, Dr. H Lowery, Mr. John McLean, Mr. Godfrey Mitchell, the Hon. Eleanor Plumer, Prof. R. V. Southwell, Mr H. V. Tewson, Mr. Henry Thirkill, and Mr. G. W. Thomson, with Mr. H. F. Rossetti and Mr. F. M. H Markham, Ministry of Labour and National Service, as secretaries.

Coal Carbonization and the Economy of Britain

THE Institute of Gas Engineers held its eightieth annual general meeting in London on June 9, and the president, Mr. E. V. Evans, surveyed the industry of coal carbonization and its place in the war and post-war economy of Great Britain. To the general public, coal is just something to burn, but in the last generation we have seen the oil industry convert a raw material into a great variety not only of fuels but also of chemical products. To-day it is generally agreed that the coal industry must do likewise. The gas industry, of all fuel industries, so far has developed the processing of coal to the greatest extent. Mr. Evans' address revealed the far-reaching ramifications of the industry in the national fuel economy. But the section which seems to merit most careful scrutiny is the discussion of what may be anticipated from a co-operative scheme in which the public utilities co-operate instead of competing in the supply of electricity and gas, each supplying the public with its product in directions for which it is most fitted. The argument assumes the existence of a town of 200,000 inhabitants with the services normally developed and with prices as at present. It assumes that in three stages conditions alter in a normal manner leading to a result which may be summarized as follows: Consumption of gas would increase fourfold, while average price per therm would fall from 10·4*d*. to 6·22*d*. Consumption of electricity would double and average price fall from 0·98*d*. to 0·7*d*. per unit. Fuel bill for the average domestic consumer would fall from £17·9 to £16. Transport of solid fuel and ash through streets would fall to less than one fifth. The total amount of coal consumed for fuel and power would be reduced from 580,000 tons to 517,000 tons. Atmospheric pollution would be practically abolished, and recovery of by-products—tar, benzole, sulphur and ammonia—increased about fourfold. These gains require only the application of existing and technical knowledge, directed according to a national plan for the efficient use of coal.

Association of Special Libraries and Information Bureaux

THE report of the proceedings of the seventeenth conference of the Association of Special Libraries and Information Bureaux held in London during November 7–8, 1942, has now been issued. It conains the papers presented at the meeting with a brief record of the discussions and in addition Mr. C. S. Orwin's paper "Agriculture and the War Stimulus", which owing to his absence was omitted from the programme. Mr. Headicar's paper "War-time Problems in Books and Binding" and Miss E. M. R. Ditmas' paper "The Special Library in Time of War", together with Sir Richard Gregory's opening address "International Systems and Standards", were not included in the reprints issued in pamphlet form for use at the Conference. In addition to the summarized discussions, the pamphlet includes reports submitted from the National Central Library and the Citizens' Advice Bureau. The eighteenth annual conference of the Association will be held in the rooms of the Royal Society, Burlington House, London, W.1, on September 18 and 19. Particulars of the programme will be available later.

Public Health in Honduras

The January issue of the *Boletín de la Oficina Sanitaria Panamericana* contains an article on this subject by the Director of Public Health, Dr. P. H. Ordónez Días, who states that public health in Honduras is making notable progress since most of the people have become health conscious. Sanitary requirements, including health certificates for employees, have been enforced in public eating and drinking places and all others in which close contact with the public is required. A Biological Institute has recently been created for the preparation of serums and vaccines. The anti-venereal campaign has been intensified by the use of arsenical preparations. In spite of free distribution of anthelmintics, infestation by intestinal parasites is still prevalent. Only sporadic cases of malaria were observed. The milk station deals with a hundred children daily and distributes 163,332 bottles and 15,394 quarts of milk during the year, with the result that the child mortality in those attending the milk station was 68·2 as compared with 105·6 for the whole republic.

Earthquakes in the Pacific

The United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has made a preliminary determination of the epicentres of three recent earthquakes in the Pacific Ocean. The first of these, on March 15, 1943, occurred at 4h. 47.9m. U.T. at an epicentre near latitude 10° N., longitude 142° E., which is in the bed of the ocean to the north-east of Fuhaesu in the Caroline Islands. The second earthquake, also on March 15, occurred at 22h. 59·2m. U.T. at an epicentre near latitude 14° S., longitude 174° W., which is in the bed of the ocean to the south-west of Savaii, Samoa, and north-east of Fiji. This earthquake had a depth of focus in the neighbourhood of 300 km. The third earthquake occurred on March 21 at approximately 20h. 35·4m. U.T. from an epicentre near latitude 6° S., longitude 146° E., which is on land in the north-east of the island of New Guinea. The exact location is just south of Astrolabe Bay and the coast town of Dein. All these earthquakes occurred in well-known seismic regions, and all interpretations and calculations are tentative, the data being received from seismological observatories to Tucson, Sitka, Honolulu, Wellington, Pasadena, Fardham, Sydney, Buffalo, Brisbane and Apia.

Announcements

The Zoological Society of London has arranged a course of popular lectures on natural history to be given at the Society's offices in Regent's Park, London. Admission is by ticket obtainable by post or at the Zoological Gardens on the day of the lecture. The first lecture will be given by Sir John Graham Kerr, who will speak on "A Naturalist in the Gran Chaco, South America", on July 28 at 3 p.m.

The following appointments, promotions and transfers in the Colonial Service have recently been made: H. S. Darling, plant protection officer, Palestine; M. Landau, assistant veterinary officer, Palestine; A. J. Kerr (agricultural officer, Uganda), senior agricultural officer, Uganda; E. T. Fern (veterinary officer, Northern Rhodesia), deputy director of veterinary services, Northern Rhodesia; J. A. N. Hobday (chief veterinary officer, Bechuanaland), director of veterinary services, Northern Rhodesia.

The Royal Society of Arts offers a prize under the Thomas Gray Memorial Trust, the objects of which are "The Advancement of the Science of Navigation and the Scientific and Educational interests of the British Mercantile Marine". The prize is of £50 and is open to any person of British or Allied nationality who may bring to the notice of the Society an invention, publication, diagram, etc., which in the opinion of the judges is considered to be an advancement in the science or practice of navigation, proposed or invented by himself during the period January 1, 1938–December 31, 1943. Entries which have already been considered by the judges in the years 1938–42 are not eligible for further consideration unless they have since been materially modified. Competitors must forward their proofs of claim between October 1 and December 31, 1943, to the Acting Secretary, Royal Society of Arts, at the above address.

According to the *Journal of the American Medical Association* of March 6, the Foundation for the Study of Cycles, New York, a non-profit organization created to foster, promote and conduct scientific research on rhythmic and periodic fluctuations in any branch of science, announces the offer of a medal to the person who, during 1943, publishes the most outstanding book or paper on the subject. The Foundation is an outgrowth of the permanent committee set up in Matamek in Canada after the first International Conference of Biological Cycles. Besides the award of a medal, the Foundation makes awards for outstanding work in each branch of science. Further information can be obtained from Dr. Ellsworth Huntington, chairman of the Committee on Awards, Hendrie Hall, York University, New Haven, Conn.

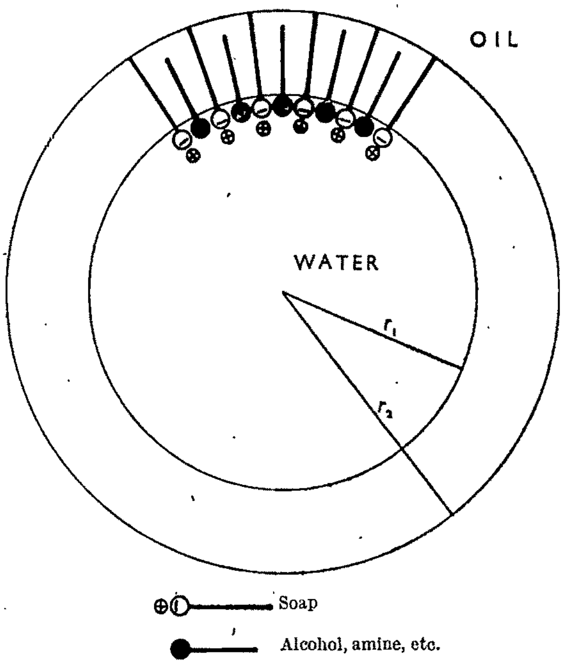
The INDEX to VOLUME 151 of "NATURE" (January to June 1943) will be published as a SUPPLEMENT to the issue for next week (JULY 31)

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Transparent Water-in-Oil Dispersions: the Oleopathic Hydro-Micelle

It is well known that oil – alkali-metal soap (or cationic soap, such as cetyl trimethyl ammonium bromide) – water systems of certain concentrations exist as transparent, electrically non-conducting dispersions, in which the oil is the continuous phase. Dilution of these systems with excess water inverts them to oil-in-water emulsions which are milky for low soap/oil ratios and transparent for sufficiently high soap/oil ratios. The transparent oil-continuous systems are familiar as 'soluble-oil' and similar concentrates: the essential conditions for their formation are (1) high soap/water ratio, (2) the presence of an alcohol, fatty acid, amine or other non-ionized amphipathic substance in mol-fraction approximately equal to that of the soap.



We believe that the properties of these systems and the conditions for their formation may be explained as follows. The disperse phase consists of sub-microscopic micelles having a core of soap-in-water solution and a surface monolayer of soap ion-pairs interspersed with non-ionized amphipathic molecules, with the hydrocarbon portions orientated outwards (see diagram). The high soap/water ratio ensures that the soap is undissociated; the presence of the water/oil interface containing orientated non-ionized amphipathic molecules allows undissociated soap ion-pairs to orientate there also, as an alternative to association in curd fibres; the non-ionized amphipathic molecules separate the soap ion-pairs sufficiently to prevent the repulsion between them that would otherwise occur, and indeed convert the repulsion in the monolayer into an attraction by forming complexes with the soap, similar to those describe elsewhere[1].

Semi-quantitative evidence can be offered in support of this hypothesis. We find, for example, tha transparent oil-continuous dispersions of the following approximate composition are quite stable, showing, however, a slight Tyndall effect:

Oil	150 parts by volume.
Water	100 „ „ „
Soap	50 „ „ „
Alcohol	40 „ „ „

If we take all densities as 1, the number of micelle containing 100 gm. of water as n, the molecula weight of the soap as 300, and the number of soa and alcohol molecules per cm.[2] of interface a $2\cdot5 \times 10^{14}$ each, we have for spherical micelles wit the radii indicated in the diagram (neglecting any soap in the bulk of the water),

$$\text{Volume of water} = \tfrac{4}{3}\pi r_1^3 n = 100;$$

$$\text{Volume of soap} + \text{alcohol} = \tfrac{4}{3}\pi(r_2^3 - r_1^3)n = 90$$
whence $r_2 = 1\cdot24\, r_1$.

Also area of water/oil interface $= 4\pi r_1^2 n$,

and hence

$$r_1 = \frac{3\ (\text{volume of water})}{\text{area of water/oil interface}} =$$

$$3 \times 100 \Big/ \frac{50 \times 6 \times 10^{23}}{300 \times 2\cdot5 \times 10^{14}} \text{ cm.} = 75\text{ A.}$$

Thus $r_2 = 93$ A., while $r_2 - r_1 = 18$ A. (compare the vertical depth of a soap monolayer, 20 A.). The micelle is therefore about 200 A. in diameter, which accords well with the optical properties of the dispersion.

A similar calculation for the transparent composition[2]

Oil	150 parts by volume
Water	100 „ „ „
Soap	100 „ „ „
Amyl alcohol	100 „ „ „
Mixed cresols	60 „ „ „

which shows scarcely any Tyndall effect, gives $r_2 = 1\cdot53\, r_1$, and by making reasonable assumptions of the depth of the monolayer we may deduce the micelle diameter as about 120 A., again in good agreement with the optical properties.

Gradual addition of water to the transparent oil-continuous system results first in the formation of an opaque emulsion, which with rather more water becomes viscous, though still non-conducting; evidently the micelles have to swell to accommodate more water, giving opacity, and then to deform owing to mutual contact, giving viscosity (addition of more *oil* to this viscous emulsion removes the viscosity but does not restore transparency, as would be expected). This spontaneous emulsification of the added water is made possible by the very low interfacial tension. Still more water inverts the system to a stable oil-in-water dispersion, because the lowered soap/water ratio permits the dissociation of the soap ion-pairs, giving the charged interface that favours ordinary hydrophilic micelles or globules[3].

We hope to extend this work by quantitative measurements on the simplest possible systems. Meanwhile, the conception of the 'inverted' micelle seems to us to be sufficiently well established qualitatively to merit description. It is the water-in-oil analogue of the hydrophilic 'swollen' soap ionic micelle, containing enclosed oil, described by Lawrence[4]; and since it contains enclosed water, and is tolerated by (though not attracted by) an oily dispersion medium, it may conveniently be termed the 'oleopathic hydro-micelle'.

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[1] Schulman and Hughes, *Biochem. J.*, **29**, 1243 (1935). Schulman and Rideal, *Proc. Roy. Soc.*, B, **122**, 29, 46 (1937). Schulman and Stenhagen, *Proc. Roy. Soc.*, B, **126**, 356 (1938). Marsden and Schulman, *Trans. Faraday Soc.*, **34**, 748 (1938). Cockbain and Schulman, *Trans. Faraday Soc.*, **35**, 716 (1939)., Lawrence, *Trans. Faraday Soc.*, **35**, 702 (1939).

[2] Reichenberg, unpublished work.

[3] Schulman and Cockbain, *Trans. Faraday Soc.*, **36**, 651, 661 (1940).

[4] Lawrence, *Trans. Faraday Soc.*, **33**, 325 (1937).

Dual Decay of Potassium

It has been known for some time that the β-ray activity shown by potassium is due entirely to the isotope ^{40}K, which thereby transforms to ^{40}Ca. One might expect that ^{40}K would exhibit a dual decay, transforming to ^{40}A either by emission of a positron or by the electron-capture process. Attempts have been made at various times to detect positrons in the radiation from potassium but without success. These experiments, however, would not have detected the electron-capture process. In 1937, von Weizsäcker pointed out that considerations of the abundance of the chemical elements suggested that the isotope ^{40}K may in fact transform by a capture process to ^{40}A. The argument was as follows. The abundance of the chemical elements varies on the whole smoothly with atomic number, and the inert gases as a class show the same variation, except that they are rarer by several powers of 10 than their neighbouring elements. Argon is a striking exception, for it is about 1,000 times more abundant than would be expected from the general rule. The excess is due entirely to ^{40}A, and argon would obey the rule if the ^{40}A atoms could be attributed entirely to the transformation of ^{40}K.

Some time ago, at the suggestion of the late Dr. Harold Walke, we examined the radiation from potassium for evidence of the K-capture process, by placing a tray containing a layer of potassium salt in a large expansion chamber.

When an electron of the K-shell is captured by the nucleus, its place must be taken almost immediately by an electron from an outer shell, with the emission of a quantum of characteristic K-radiation. In the present case, the quantum will be emitted by an argon nucleus and its energy will be rather less than 4,000 electron volts. Practically all the radiation escaping from the layer of potassium salt into the air of the chamber will be absorbed within a few centimetres of the source. The absorption of each quantum gives rise to a photo-electron of about 0·5 mm. range, appearing in the cloud chamber as a large spot, easy to distinguish from any background cloud which may be present. The expansion chamber thus affords a sensitive method for the detection of the capture process, provided that the β-rays from the source of potassium salt are bent away by a strong magnetic field so as not to interfere with the observation of the spots.

In the course of the experiments 172 photographs were taken, some using layers of potassium chloride and some potassium nitrate; on these, twenty-eight large spots were observed, nearly all within 3–4 cm. of the source. There is good reason to believe that these spots are not a background effect of the chamber, for 117 photographs, taken under similar conditions except that layers of sodium salts were used, showed only two spots; while fifty photographs with no source gave no spots. The results show therefore that potassium emits an X-radiation of about the expected quantum energy, but it must be borne in mind that this radiation might arise from other processes than the K-capture process; as, for example, by the ionization of the K-level of potassium by the β-radiation. Calculation indicates, however, that these other effects are far too weak to account for the observations, and there seems to be little doubt that the K-radiation arises from the electron capture process

$$^{40}\text{K} \rightarrow {}^{40}\text{A}.$$

An estimate has been made of the probability of this process relative to the known β-transformation to ^{40}Ca. Owing to the great absorption of the K-radiation in the layer of salt and the uncertainty of the absorption coefficient, the calculations are very rough. They lead to the conclusion that the branching ratio is about three or four disintegrations by electron capture to one by electron emission, whereas von Weizsäcker estimated the ratio to be 1 to 3. As both estimates are liable to large errors, the discrepancy cannot be regarded as serious.

Recalculating the half-value period of ^{40}K to take account of this alternative mode of decay, we arrive at a value of about 4×10^8 years, not an unreasonable figure.

It would be interesting to be able to show that old potassium minerals, for example, granites or potassium feldspars, contain argon in amount corresponding to their age and potassium content. There exists already evidence of the presence of argon in granites[1] but its significance is not clear, for it is difficult to exclude completely the possibility of atmospheric contamination. The outbreak of war and the pressure of other interests prevented us from pursuing this aspect of the problem, and there seems little prospect of our being able to take it up for some time. For this and other reasons we make known our results, although not as complete as we would wish, without further delay.

F. C. Thompson.
S. Rowlands.

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June 21.

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[1] cf. Rayleigh, Nature, **141**, 410 and 970 (1938); and Shepherd, *Amer. J. Sci.*, **35A**, 311 (1938).

Nature of Tetraploidy in Cultivated European Potatoes

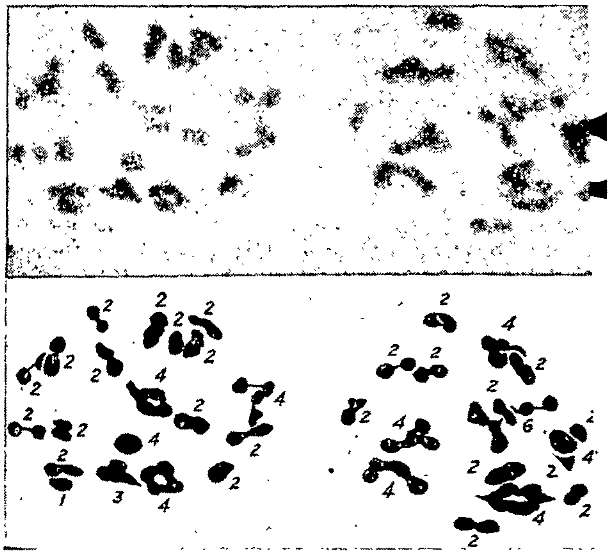
It must be unusual to find that the essential details of the genetic behaviour of an economic crop of such standing as the potato can still offer fertile grounds for controversy. Yet such is indeed the case.

The relevant facts of the cytogenetic situation are briefly these. The family Solanaceæ, to which the potato belongs, appears to be characteristically polyploid on the basic number 12, $2n = 24$ being the lowest chromosome number actually found. The European cultivated potatoes with 48 somatic chromosomes might therefore be suspected of being tetraploids. The published data on meiosis are, however, insufficient to establish the nature of tetraploidy. Although quadrivalents have been seen by Stow[1], Meurman and Rancken[2] and Ellison[3], there is no precise information on the frequency of their occurrence. In the genetic literature, on the other hand, two opposing views are to be found. The earlier workers, for example, Salaman[4], and more recently Black[5] and Collins[6], regarded the plants as functional diploids. The genetical possibilities of tetraploidy, though perhaps appreciated by K. O. Müller[7] in 1930 and by Asseyeva and Nikolaeva[8] in 1935, were not fully considered until 1937[9], a decade after the publication of the initial cytological facts just outlined. To this situation must be added a further complication in the shape of speculations on the true basic number of the solanaceous polyploid series. Assuming this to be 6 and not 12, allo-octoploidy has been proposed[3] though not as yet employed as a working hypothesis for potato genetics.

The choice essentially lies between a disomic and a tetrasomic interpretation of inheritance in this plant. Data which would critically distinguish between these alternatives are not yet fully available, but there is a growing weight of evidence in favour of tetrasomy. Thus some genetical work recently published[10] has shown a tetrasomic segregation of the dominant allele of the gene *nx* controlling a lethally necrotic reaction to infection with virus X. Further, from certain consistent deviations in these segregations it was concluded that the four *nx*-carrying chromosomes must, in a proportion of cases, pair and exchange partners and must therefore be homologous. This was suggestive of autopolyploidy, and the prediction was made that inspection of meiosis would reveal a comparable frequency of quadrivalent formation. The confirmation of this prediction which is now to hand is the reason for publishing this note.

	Multivalents per Cell													Total Cells
No of Multivalents	0	1	2	3	4	5	6	7	8	9	10	11	12	
No. of Cells	1?	—	4	5	13	15	15	11	4	2	—	—	—	70

The accompanying table contains the numerical data for the occurrence of multivalent groups in the pollen-mother-cells of the variety Flourball, obtained after fixation in acetic alcohol and staining by the Feulgen technique. Multivalents include trivalents, quadrivalents and a small number of groups of higher valency which will be referred to again below; the great majority are, however, quadrivalents. Variation in the proportions of multivalents is considerable, but about half the chromosomes present are generally involved. This is the case in the two cells figured, one of which has five multivalents, the other having six. The probable analysis of these cells may be made with the help of the labelled diagram. The two extreme cases listed with 9 multivalents are, however, the most instructive from the point of view of chromosome homology. One of these contained 8 quadrivalents and 1 trivalent and univalent; the other, 7 quadrivalents and 2 trivalents and univalents. Since the ability to form a quadrivalent must always denote a measure of homology between the four chromosomes involved, it would appear that at least 8 chromosomes are present in quadruplicate. This is a sufficiently high proportion of the possible maximum of 12 quadrivalents to be strongly suggestive of autopolyploidy on cytological grounds alone.



a *b*

Upper, photomicrograph of 2 pollen mother cells at late diakinesis from the variety Flourball from a permanent mount after Feulgen staining (× 1500). Lower, diagram showing probable analysis of configurations.

Quadrivalents have been seen in incompletely analysable material of at least four other varieties of potato dealt with in my earlier communication.

With regard to the groups of higher valency than four, one of these was encountered in each of eight cells, three of which showed a pentavalent, five a hexavalent and two an octovalent; a ninth cell showed two pentavalents. A hexavalent is visible in the accompanying figure (*b*). These cells represent only a small proportion of those analysed and they are best interpreted as signs of segmental interchange between two non-homologous chromosomes. Examples of similar multivalents ranging from penta- to octovalents are described in other potato varieties by Meurman and Rancken[2] and Ellison[3]. A minor amount of structural hybridity of this kind is not unexpected in a plant in which vegetative propagation predominates. Apart from this both cytological and genetical evidence agree in assigning autopolyploidy to the European potatoes. The likelihood of their hybrid origin in the genetical sense is, however, not thereby excluded.

I am indebted to the Agricultural Research Council for the provision of optical equipment and to Dr. I. Manton for help and advice.

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[1] Stow, I., *Jap. J. Bot.*, **3**, 217 (1927).

[2] Meurman, O., and Rancken, G., *Soc. Sci. Fennica Comm. Biol.*, **3**, 1 (1932).

[3] Ellison, W., *Genetica*, **18**, 217 (1936).

[4] Salaman, R. N., *J. Gen.*, **1**, 7 (1910).

[5] Black, W., *J. Gen.*, **30**, 127 (1935).

[6] Collins, E. J., *Ann. Bot.*, **49**, 479 (1935).

[7] Müller, K. O., *Angew. Bot.*, **12**, 299 (1930).

[8] Asseyeva, T. O., and Nikolaeva, N., Works Pot. Res. Inst. Moscow No. 9 (1935).

[9] Lunden, A. P., *Meld. Norg. Landbr. Høisk.*, **17**, 1 (1937).

[10] Cadman, C. H., *J. Gen.*, **44**, 33 (1942).

Vitamin B_1, Vitamin B_6 and Biotin as Growth Substances for some Ascomycetes

IN continuation of earlier published investigations[1] on the significance of vitamin B_1 (aneurin, thiamin) and biotin (vitamin H) for the growth of different fungi, the need for growth substances of a number of Ascomycetes has been more closely studied. Leaving aside yeast-fungi, only relatively few of these have been more thoroughly examined in this respect[2].

The genus Ophiostoma (Ceratostomella) was found to include species with the most varying need of accessory growth substances. All the nine species examined required one or several growth substances to grow on synthetic media.

TABLE 1. THE EFFECT OF DIFFERENT GROWTH SUBSTANCES ON 9 SPECIES OF OPHIOSTOMA IN SYNTHETIC MEDIUM. (Bn = BIOTIN METHYL ESTER, Pyr = PYRIMIDINE, Thi = THIAZOLE.)

Species tested	Effective growth substances	
	Indispensable for growth	Growth-stimulating but not indispensable
O. piceæ	B_1 (Pyr)	—
O. stenoceras	B_1 (Pyr)	Bn
O. coeruleum	B_1 (Pyr)	B_6, Bn
O. quercus	B_1 (Pyr)	B_6, Bn
O. pini	B_1 (Pyr), Bn	B_1 (Thi)
O. ulmi	B_6	B_1 (Pyr ?)
O. fagi	B_6	Bn
O. piliferum	B_6	Bn
O. multiannulatum	B_1 (Pyr + Thi), B_6	—

The significance of vitamin B_6 (adermin, pyridoxin) is noteworthy for several of the examined species; at least six species reacted positively on an addition of this growth substance, and a closer examination showed that four of these had no, or in any case insufficient for growth, ability to synthesize vitamin B_6. One species, *O. multiannulatum*, required B_1 besides B_6. The table shows, furthermore, that B_1-heterotrophy occurred within a number of species; in one particular case, *O. pini*, combined with biotin-heterotrophy. Generally there was no need to add the entire B_1-molecule; supplied with only pyrimidine (2-methyl-4-amino-5-aminomethyl-pyrimidine hydrochloride) the organism itself was able to produce for the synthesis of vitamin B_1 the necessary thiazole.

Successful experiments to effect 'artificial symbiosis' proved that it was a question in these cases of a more or less complete loss of synthetic ability. Two species—no matter which two—one requiring B_1 (but producing B_6), the other requiring B_6 (but producing B_1), could consequently grow together on a substratum without addition of growth substances.

The weakest concentration of vitamin B_6 which exercised an observable effect was about 10^{-10}; it was nearly the same as earlier established, being valid for vitamin B_1 and biotin for those fungi reacting to these growth substances. An especially favourable bject for studies of the quantitative effect of B_6 proved to be *O. multiannulatum*. This fungus with the addition of suboptimal quantities of B_6 to a nutrient solution, otherwise optimal, produced quantities of mycelium, which, within certain limitations, were directly proportional to the added B_6-quantities. The same holds good also for *O. ulmi*, which, howver, showed a certain lability in regard to the B_6-heterotrophy.) The mycel./B_6-quotient thus obtained was of the same magnitude—about 500,000—as the earlier ascertained mycel./B_1-quotient of other fungi. Therefore with *O. multiannulatum* as test-object, it should be possible to carry out quantitative B_6-determinations in roughly the same manner as is employed with the B_1-determinations by means of Schopfer's Phycomyces-test[3].

Other ascomycetes which have here been examined have generally proved to be auxo-autotrophic or B_1-heterotrophic. Besides earlier known representatives of the latter type, *Discula pinicola* and *Diaporthe detrusa* may be mentioned here.

From certain points of view *Mitrula paludosa* is an interesting example of a fungus requiring biotin. Already it has been shown that biotin is a necessary factor for germination of the spores. For good growth in a synthetic medium vitamin B_1 also is required. The need of biotin for growth seems, however, in a peculiar way to be connected with the source of nitrogen; for example, *M. paludosa* with NH_4-nitrogen is unable to grow without the addition of biotin, while the fungus in question, on the other hand, grows quite well without biotin with NO_3-nitrogen, especially if the substratum is relatively acid.

A detailed account will be published in *Symbolæ Botanicæ Upsalienses.*

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June 2.

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[1] Fries, N., *Symb. Bot. Upsal.*, **3**, 2 (1938).

[2] Cf. Hawker, L., NATURE, **142**, 1038 (1938). Robbins, W. J., and Kavanagh, F., *Amer. J. Bot.*, **25**, 229 (1938). Schopfer, W. H., and Blumer, S., *Arch. Mikrob.*, **11**, 205 (1940). Melin, E., and Midén, G., *Svensk Bot. Tidskr.*, **35**, 333 (1941).

[3] Schopfer, W. H., and Jung, A., C. R. 5e Congr. Int. Techn. Chim. Indust. Agric. Schévéningue, 22 (1937).

Breakdown of Paraffin Wax by Bacteria: A Source of Error in Corrosion Tests

IN work carried out by the British Non-Ferrous Metals Research Association on the corrosion of metals by domestic waters, glassware used for sampling water and for carrying out corrosion tests was coated with paraffin wax to prevent pick-up of alkali silicates. Tests carried out in waxed containers, or with water conveyed in them, gave inconsistent and non-reproducible results. It was observed from time to time that the wax coatings of some of the carboys were attacked and gradually disintegrated. In view of our previous experience of bacteria in altering the corrosive properties of waters, the possibility of bacterial action was considered.

Water from a carboy showing disintegration of the wax was inoculated into a sterile nutrient solution[1] containing no other source of carbon than flakes of the paraffin wax, and incubated at 30° C. After a few days a growth of bacteria was obtained which was attacking the wax. The species of organism responsible for the fermentation was not fully worked out, but it was found to be a coccus and possibly was a strain of the *Micrococcus paraffinæ* cited by Söhngen[2], who states that these bacteria are aerobic, of soil origin, and are commonly found in surface waters.

Bacterial activity in any water is bound to change its characteristics, and one of the variations investigated was the effect of this bacterial action on the apparent free carbon dioxide content of waters stored in waxed containers. A series of waxed and stoppered Winchester bottles, each partially filled with tap water and inoculated with cultures of bacteria known to attack the wax, was set up. Free carbon dioxide determinations were then made on the water in the Winchesters*. The interval before the first determination was made varied with each bottle, and the bottles were re-stoppered between each measurement.

For comparative purposes two unwaxed bottles containing the same water uninoculated were stoppered and tested over the same period.

The experiment showed that water in closed waxed containers contaminated with wax-attacking bacteria increased its free carbon dioxide content on storage as much as twenty times in forty days, whereas there was no change in the apparent free carbon dioxide content of the water in the two unwaxed bottles. It was possible to stop the activity of the bacteria by sterilization with heat or disinfectants.

It is known that the presence or absence of carbon dioxide in a water is a most important factor in determining its corrosive action, and the accompanying table illustrates the variation of corrosive attack which can occur if bacteria capable of attacking wax are present in a corrosion experiment where such a substance is used.

EFFECT OF WAX BACTERIA UPON CORROSION OF A DOMESTIC WATER IN METAL PIPES CLOSED AT BOTH ENDS WITH WAX.

Condition of water	Corrosion rate
Untreated water free from wax bacteria	0·9
Water inoculated with wax bacteria	4·1
Sterilized water	0·7
Sterilized water re-inoculated with wax bacteria	4·0

It is believed that other corrosion investigators may use paraffin wax in their work, and if this is so it is imperative that they should be on their guard against the action of these bacteria.

Although the observations have shown that the apparent free carbon dioxide content of a water may be increased by the action of certain bacteria on wax, it must be pointed out that many other microbiological processes normally occurring in natural waters are accompanied by a change in the carbon dioxide content of the water. We are therefore of the opinion that a correct assessment of the corrosive properties of a natural water cannot be made unless the biological state is taken into account. It is seldom safe to assume that any sample of natural water that has been stored for any length of time is representative of the water from which the sample was taken originally.

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* By titration with $N/20$ Na_2CO_3 using phenolphthalein as indicator. Any organic acids which might be formed by the action of the bacteria would be estimated as free carbon dioxide.

[1] Waksman: "Principles of Soil Microbiology", p. 204 (1927).

[2] Söhngen, N. L., *Centrbl. Bakt.*, II, 37, 595 (1913).

Library Stocks of Periodicals

AFTER this War, even more than after the Wa of 1914–18, learned and scientific libraries in Grea Britain will be faced with the problem of attempting to fill gaps in their sets of periodicals caused not only by the inability to obtain journals from enemy and enemy-occupied countries during the war-period, bu also by losses at sea and by destruction in air-raids As stocks in European countries may also have been destroyed in air-raids, there is likely to be a shortage in many cases, and in order to prevent an unseemly scramble on the part of individual libraries to ge volumes of which there may be an insufficient numbe of copies to go round, it is highly desirable that a representative and impartial body should decide, or a national scale, to which libraries the available copies should be allotted.

This allocation should form part of a much large scheme whereby the present holdings of learned periodicals in all important libraries in Great Britain would be surveyed and the needs of research in the various centres of learning assessed, due regard being had to existing subject specializations in variou institutions. Interchanges of stock could then be arranged so as to ensure the presence of complete sets of important publications in the libraries where they are most needed, and the elimination of many incomplete sets where they are little used. This may entail on the part of some libraries the sacrificing of treasured possessions, but it would be greatly to the benefit of research workers as a whole.

The obvious body to undertake responsibility for this work is the Library Association, which by its royal charter is entrusted, among other tasks, with promoting the better administration of libraries and encouraging bibliographical study and research. In practice, it will probably be found most economical for the actual work to be done at the National Central Library, where the machinery for this kind of undertaking already exists and would only need expanding Funds for this purpose would no doubt be forthcoming.

It may be mentioned that at least two such schemes in limited fields of knowledge, those of German studies and of medicine, were already being prepared before the War. The former, which was being undertaken by the Joint Standing Committee on Library Co-operation of the Association of University Teachers, had, I believe, reached the stage of recommending the transfer of stocks; the latter, a much larger undertaking under the auspices of the University and Research Section of the Library Association was only in the preliminary stage of making the survey of holdings, when it was interrupted by the War. Possibly a further extension of such specia subject-schemes might be the best way of tackling the job.

In any event, until the work has been done it would certainly seem premature for any fresh union catalogue of periodicals in British libraries to be undertaken, because its work would be so soon ou of date and therefore a waste of money.

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RESEARCH ITEMS

zes of Virus Particles

THE estimation of size of ultra-visible virus par-cles presents many difficulties, and it was perhaps evitable that determinations by various workers sing different methods gave discordant results. An xhaustive and critical review of the whole question, y Roy Markham, Kenneth M. Smith and Douglas ea (*Parasitology*, 34, 315; November 1942), provides basis for the common interpretation of various ethods. Channels of approach to the determination f particle-size include ultra-violet light and electron icroscopy, X-ray diffraction, sedimentation and iffusion, filtration, and radiation inactivation, and ll are discussed in the present paper. The authors ecognize the great probability that viruses are often onsiderably hydrated, and particle-size would then e greater than in the dry state. One slight criticism ight be advanced—that very little notice is taken f the *p*H of the virus suspension. This would robably affect the size of protein virus particles, hich would be smallest at the iso-electric point. he literature on virus-sizes is condensed into three ables dealing with animal viruses, plant viruses and acteriophage. It is considered, however, that the agnitude of only three viruses can be stated with xactitude. Vaccinia virus is 235 mμ diameter in he hydrated state, and 200 mμ when not hydrated. he unhydrated virus of tomato bushy stunt averages 9·2 mμ in diameter, with molecular weight 10·65 × 0^6. Hydration increases these values to about 7 mμ for the diameter, and 18·8 ± 5·0 × 10^6 for olecular weight. Tobacco mosaic virus is rod-haped, 280 mμ × 15·2 mμ in the unhydrated con-ition, though it may aggregate to 532 × 15·2 mμ. ocumentation of the evidence shows a masterly horoughness, and the research worker in this field ill find the paper an invaluable summary.

iapause in the Eggs of a Grasshopper

IN considering cases of arrested development in insects it is logical to separate those directly due to environmental causes from those in which development is inhibited by some factor or factors internal to the organism. In the former case, normal development will be resumed as soon as the organism is returned to the right environment: in the latter case development continues to be inhibited even though the organism is experiencing apparently favourable temperature and humidity. H. E. Andrewartha discusses the phenomenon of diapause in the grasshopper *Austroicetes cruciata* Sauss. in South Australia (*Bull. Entomol. Res.*, 34, Pt. 2; 1943). It appears that this insect enters a state of diapause when in the embryo state only a few days after the egg has been laid. Diapause was eliminated from the eggs by exposing them to suitable low temperature (between 6° C. and 13° C.) for adequate periods when the embryo was at a suitable stage in development. If the exposure to low temperature was inadequate or inadequately timed, diapause was not eliminated. The influence of low temperature on diapause was due chiefly to changes which occurred in the yolk under the exposure. Yolk which had become modified in this way is stated to become suitable for the nourishment of the embryo and also allows it to move over the yolk during blastokinesis. Eggs exposed to a constant temperature of 16°–25° C. failed to develop fully: growth was slow and katatrepsis or re-orientation of the embryo as the result of movements during blastokinesis did not occur. Apparently this was due to the yolk being in an unsuitable condition to allow of the embryonic movement over the yolk surface. Prolonged exposure to 16°–25° C. (100–150 days) enabled the embryo to grow to a stage at which exposure to suitable low temperature eliminated the diapause. Intermittent exposure to 10° C. and 25° C. enabled the eggs to reach a similar stage of development.

Bacterial Growth

IN three papers by R. M. Lodge and C. N. Hinshelwood (*J. Chem. Soc.*, 208; 1943) the growth of *Bact. lactis aerogenes* in various media is described, with special attention to departures from the logarithmic growth curve. In a synthetic medium containing ammonium sulphate or amino-acids as the sole source of nitrogen, the results suggest that the maximum population is in part controlled by the formation of an inhibiting substance removable by cellular oxidation; that the earliest stages in the utilization of amino-acids is not usually rate-determining; and that the mutation involves a slight change in the delicate balance of these and other reactions. The lag between inoculation and the establishment of the logarithmic growth has been examined and is found to depend, among other things, on the age of the culture, and a lag-removing diffusible substance is produced by an actively growing culture. On storage for some months in a meat extract medium a strain of the bacterium showed in synthetic media an increased growth-rate, an increased stationary population, and a greater response to aeration. Variation could not be obtained in artificial media.

Coat Colour and Behaviour

C. E. KEELER (*J. Hered.*, 33, 371; 1943) has continued his investigation on the degree of tameness of varieties of the Norway rat. The F_2 of an albino carrying a black gene crossed with a wild grey rat was analysed by various tests for tameness. In 125 segregates it was found that the black-coated rats were less savage and more easily handled than their grey-coated sibs. It is believed that there is a pleiotropic effect of the gene for black-coat colour, in that the gene itself influences the temperament. It was found also that the gene for albinism has a profound dulling effect on the sense of smell.

Soil Moisture and Wilt Disease

IN the Niagara Peninsula in 1940 wilts due to *Verticillium albo-atrum* R. and B. occurred on a number of hosts, and Colin D. McKeen reports (*Canadian J. Res.*, March, 1943) the results of an extended series of investigations designed to ascertain the factors leading to such epidemic outbreaks, which occur only occasionally in the Peninsula. It is found that there is a very definite optimum temperature for the development of the pathogen in the soil and that an outbreak of disease is only to be expected when such soil temperatures coincide with the presence of relatively high values of soil moisture. This only occurs rarely in this locality, which thus usually escapes serious trouble from Verticillium wilt, because of the low soil moisture throughout that part of the growing period during which soil temperatures favour the growth of the fungus.

Almonds in Great Britain

A SHORT paper by H. Amphlett Williams (*J. Roy. Hort. Soc.*, 68, Pt. 3; March 1943) surveys the possibility of using almond nuts grown in Britain for human consumption during the present shortage. Nuts of *Prunus Amygdalus amara*, *P. A. Pollardii*, *P. tenella* (*P. nana*) and *P. Amygdalo-persica* contain dangerous quantities of hydrocyanic acid, but may be used in small quantities for flavouring, in the same way as bitter almonds. *P. Amygdalus* (*P. communis*) and its variety *praecox* produce about one twentieth of the hydrocyanic acid yielded by bitter almonds, and the nuts may be used in moderation for dessert and cooking purposes. Almond nuts from *P. A. macrocarpa* and *P. A. dulcis* make practically no hydrocyanic acid. It thus appears that the decorative almond trees (varieties of *Prunus Amygdalus*) in the neighbourhood of London could provide a welcome qualitative addition to war-time cookery.

Willows of Saskatchewan

IN the *Canadian Field Naturalist* (66, No. 7, Oct. 1942) there is an interesting paper "Notes on the Willows of Saskatchewan", by W. P. Fraser, emeritus professor of biology, University of Saskatchewan. The paper is based on collections and study made in the southern half of the province, and did not extend into the northern unsettled areas farther north than about the 54th parallel. The collectors co-operated in the exchange of specimens and notes, and this added to the interest and the amount of information obtained. It also resulted in the accumulation of a representative collection from this area in the herbarium of the University of Saskatchewan, and the present study is based upon them.

Synthesis of some α-Acyltetronic Acids

DERIVATIVES of α-acyltetronic acids are frequently found as products of mould metabolism, and the synthesis of such compounds is, therefore, of interest. Benary in 1909 obtained α-acetyltetronic acid in unspecified yield by condensing chloracetyl chloride with ethyl β-aminocrotonate in pyridine, cyclizing the resulting ester by heating, and deaminated the product by alkaline hydrolysis, obtaining α-acetyltetronic acid. Wilson Baker, K. D. Grice and A. B. A. Jansen (*J. Chem. Soc.*, 241; 1943) find that this acid is readily synthesized from β-anilinocrotonic ester and chloracetyl chloride. The methyl group of the acid is reactive and condenses with several aldehydes to form unsaturated compounds which can be reduced to the saturated α-acyltetronic acids. All the tetronic acids are very strong, the anion being stabilized by a resonance distribution of the charge between the oxygen atoms of the acidic hydroxyl group and the ester carbonyl group.

Solubility of Metals in Mercury

MOST metals dissolve slightly in mercury and they also react chemically with it to form intermetallic compounds. Platinum deteriorates slightly with age and becomes brittle with long exposure to it. Iron and tungsten seem inert, which may be due in part to the protection of adherent surface films of oxide, Lead, tin, zinc, and cadmium are sufficiently soluble to alter the properties of the mercury, which makes them unsuitable for use in contact with it in mechanical devices. According to an article by C. H. Prescott, jun. (*Bell Lab. Rec.*, 21, No. 4; Dec. 1942), the solubilities in mercury of silver, copper, nickel and platinum, and of iron and stainles steel, have been determined recently by the Be Laboratories by a new method employing a circulating still of 'Pyrex' glass. Mercury is evaporated fro a boiler into a condenser and then flows through bulb packed with scraps of the metal the solubilit of which is being determined, back into the boile The bulb which contains the metal sample is held i an oil thermostat at a temperature of 100° C. Sinc the mercury moves slowly, it becomes saturated wit metal which is precipitated in the boiler. Th solubility of silver was found to be 0·0018 gm./gm of mercury and that of copper was 0·00013 gm./gm The experiments on silver and copper were finishe in three and thirteen days respectively, which time correspond inversely to their solubilities. Nickel an platinum are so much less soluble that experiment on them required three and seven months respectively The solubility of nickel was $1 \cdot 4 \times 10^{-7}$ gm./gm and that of platinum was $4 \cdot 6 \times 10^{-9}$ gm./gm With iron and stainless steel, the boilers were perfectly clean after eight months. Solubility in mercury however, is only part of the story. The surfaces o silver, copper, nickel and platinum are easily wette and remain covered with a fluid film of mercury The material in equilibrium with mercury in thes experiments is, however, not the metal itself, but layer of solid amalgam. Actually, the metal mus be somewhat more soluble than the amalgam. Thu as it slowly dissolves, it is re-precipitated as a intermetallic compound which covers the surface an retards further attack.

Load Distribution between Interconnected Power Stations

IN a paper by Paul G. Kaufmann (*J. Inst. Elec Eng.*, 90, Part 2, No. 14; April 1943) on this subject the load distribution in a system of interconnecte generating stations is examined analytically wit the view of obtaining maximum system efficiency The author shows a graphical method of solving th general problem and discusses automatic load distribution, safety devices, and frequency control. A mathematical study of the problem is given in a appendix.

Notation of Elliptic Functions

IN a lecture to the London Mathematical Societ on June 17, Prof. E. H. Neville described an effectiv modification of notation in the theory of Jacobia elliptic functions. He replaces the classical symbol K, iK' for the quarter-periods by K_c, K_n, writes K_d for $-(K+iK')$, and attaches the symbol K_s to th origin. The result is to confer on the usual notation for the functions a structural significance; thus th function which, after Glaisher, is denoted by pq$u$ (where p, q are any two different letters chosen from s, c, d, n), is a function with a zero at K_p and a pole a K_q. General theorems and comprehensive formulæ now replace the sets of individual theorems and particular formulæ with which the subject has been overburdened. For example, the function pq$u$ has K_p+K_q for a half-period, and the identity K_s+K_c $+K_n+K_d=0$ exposes at a glance the classification of the twelve functions in terms of periodicity. Prof. Neville expressed the characteristic property of the Jacobian functions as a standardization of the lattice to which the functions are attached, and showed how from this point of view the general features of the fundamental transformations of Jacobi and Landen are obvious and the details are discoverable almost without calculation.

PHYSIOLOGICALLY ACTIVE FRACTIONS OF INDIAN HEMP

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IN spite of nearly fifty years of intensive study, the chemistry of hemp resin is still obscure. Earlier orkers reported that the active ingredient of Indian emp was not an alkaloid[1] but a resin[1,2] with oiling point 265° C. and a chemical composition epresented by $C_{18}H_{24}O_2$ ('crude cannabinol' of Cahn[8]). Wood, Spivey and Easterfield[3] showed that the high-boiling resin was a mixture of at least two comounds and isolated from it a pure crypto-phenol, *annabinol*, $C_{21}H_{26}O_2$, $d_D = -108°$, which formed a rystalline acetyl derivative, melting point 75° C. Later investigators[4,5,6,7] obtained apparently *contant boiling resins* to which they assigned the ormulæ $C_{21}H_{30}O_2$ or $C_{20}H_{30}O_2$. Work by Cahn[9] has onfirmed the findings of Wood, Spivey and Eastereld (*loc. cit.*). Myttenaere[10], on the other hand, elieves that cannabinol is not a pure entity but ontains several isomeric compounds, some of which re soluble in dilute alkalis, whereas others are nsoluble in them. The possibility of spontaneous onversion of the alkali-soluble compounds to alkali-nsoluble ones by heat or at room temperature has lso been suggested. The active constituents of ndian cannabis resin, according to the present state f our knowledge, are: (1) *cannabinol*[3,8], $C_{21}H_{26}O_2$, $_D = -108°$, which forms a crystalline acetyl erivative of melting point 75° C.; (2) *cannabol*[11], hich is isomeric with '*cannabidiol*'; (3) *cannabidiol*[12] ossibly in traces in Indian hemp), $C_{21}H_{30}O_2$, $(L)^{27} = -125°$, melting point 66–67° C., found in both gyptian and American hemp.

Very little systematic pharmacological work seems have been carried out on the various fractions btained from cannabis resin, and considerable eculation still exists as to which of the natural mponents isolated in a pure state is its characristic action due. Marshall[13] observed in 1897 that *nnabinol* (probably 'crude cannabinol', as pure nnabinol was isolated only in 1899) was physiogically active on human beings. Cahn[8], on the ther hand, reported that cannabinol, though toxic, as not the pharmacologically active component. ork, Bergel and Todd[14] leaned towards the same iew, in that they found the cannabinol-free resin to e the more potent physiologically. According to Adams *et al.*[12], *cannabidiol* is inactive. No report is available regarding the activity of 'cannabol' on laboratory animals or human beings.

The estimation of the narcotic potency of hemp drugs is important, particularly from the point of view of excise administration, and several chemical (Beam's test[15], vanillin test[16]) and physical (polarimetric test[17]) tests have been devised to measure this activity. However, none of these tests is considered satisfactory, as it is still open to question whether the tests measure the truly narcotic constituent of hemp resin.

An attempt was therefore made to study the pharmacological activity of various fractions of charas obtained from authentic Indian sources through the courtesy of Dr. H. B. Dunnicliff, director of the Central Revenues Control Laboratory.

1 gm. of charas was extracted in a Soxhlet extractor with 50–75 c.c. of carbon tetrachloride. The extract was shaken with 0·5 per cent sodium hydroxide solution. This was acidified and re-extracted with petroleum ether, the residue being taken up in every case with carbon tetrachloride. The following fractions were obtained: (1) carbon tetrachloride extract of genuine charas; (2) carbon tetrachloride extract of alkali-insoluble portion of charas; (3) carbon tetrachloride solution of alkali-soluble but petroleum-insoluble fraction of charas; (4) petroleum-ether extract of the alkali-soluble portion of charas.

EFFECT OF VARIOUS FRACTIONS OF HEMP RESIN IN CATS AFTER EVAPORATING THE SOLVENTS *in vacuo* AND TAKING UP THE RESIDUE WITH ALCOHOL.

Name of fraction	Principles likely to be present	Total number of experiments	Positive cannabis response Dose: c.c./kgm.	Onset of signs (hours)	Negative cannabis response Dose: c.c./kgm.	Absence of signs (hours)
CCl_4 extract of genuine charas.	All phenols—Cannabinol, Cannabidiol, Cannabol, etc.	26	1·61	1·75	—	—
CCl_4 extract of alkali-insoluble fraction of charas.	Cannabinol and some of its isomers ?	24	0·86	1·48	—	—
CCl_4 solution of alkali-soluble but petroleum-insoluble fraction of charas.	Some phenols excepting the alkali-insoluble portion of cannabinol.	30	—	—	2·96	3·40
Petroleum ether extract of the alkali-soluble fraction of charas.	*ibid.*	20	—	—	3·00	3·18

The well-known Gayer's test[18] was employed on cats for pharmacological evaluation. All the animals weighed between 2·0 to 3·0 kgm. and were kept in the laboratory for at least four days on laboratory diet before experiments were started. The animals were fasted overnight before the drug was given by means of a Ryle stomach tube. In the accompanying table, results obtained from nearly a hundred experiments have been included. These were collected from cats found sensitive to cannabis action, and the maintenance of the initial degree of responsiveness was continually checked by cross experiments and interpolation of initial effective dose of whole charas when no cannabis response was obtained with the alkali-soluble fractions. The drug was administered in a small volume of absolute alcohol having no effect on animals. The solvent was evaporated *in vacuo* because of the toxic effect of carbon tetrachloride on cats even in small doses. Positive cannabis response was indicated by initial excitement, followed by inco-ordination, rocking movements of the head, sluggish corneal reflex, somnolence, and mild narcosis.

It will be seen from the above that the alkali-insoluble fraction (containing cannabinol, etc. (?)) was found to be the pharmacologically active fraction under the conditions of our experiments. The alkali-soluble fractions even in three times higher dosage and in the same experimental conditions did not reveal any narcotic activity. This raises the question as to whether 'cannabinol' could be considered as a physiologically inactive phenol, as has been indicated in previous reports[8,13].

Unless further experimental work is done with pure cannabinol, it seems too premature to hazard any definite statement regarding its physiological potency. It may, however, be presumed from the biological assay results on the alkali-insoluble fraction of charas that possibly *cannabinol* may be the precursor of the true active ingredient, the phenol being broken down in the system to some other derivative possessing the ethenoid linkage but with more intense physiological activity. The synthesis by Adams and his co-workers[12] of some tetra-hydro-cannabinols possessing strong hashish activity also lends support to this supposition.

Our thanks are due to Sir R. N. Chopra and Dr. H. B. Dunnicliff for their continued interest in this work.

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[15] Beam, Wellcome Trop. Res. Lab., 4th Rept. (*B*), 25.

[16] 'Vanillin test', cited by Fulton, C. C., *Ind. Eng. Chem.*, **14**, 407 (1942).

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FISHERIES RESEARCH IN AUSTRALIA

VALUABLE research in biological fishery problems is being carried out by the Council for Scientific and Industrial Research, Commonwealth of Australia. The primary objective of the current investigation* is to obtain a well-founded estimate of the pelagic fishery resources of Australian waters, and in this is included oceanographical work concerned with changes in currents and water conditions generally, together with their effect on the amount and distribution of plankton. Roughly speaking, the course of the fisheries varies according to the ever-varying conditions of the sea. The report on the pelagic Tunicata is of importance as the members of this group serve as indicators of changing ocean graphical conditions which affect the course of t fishery.

This is the first report to be published on t investigations covering the period from May 1938 January 1941, carried out by the motor ves *Wareen*. During this period the whole south-ea Australian area was repeatedly traversed, a oceanographical observations were made as frequent as they could be without interfering with the mc specific fishery investigations. An intensive study h been made of the pelagic Tunicates which, except f Crustacea, form the chief portion of the zooplankto The Tunicates are much more abundant in the su tropical and tropical waters than in the great fishe area of the colder portions of the northern hemispher No species typical of sub-antarctic (cold wate influences are found, those present being main circumtropical and sub-tropical.

Comparison of species and their relative numbe with those of other regions indicates a much clos affinity with south Japanese and Philippine a Indo-Malayan than with Californian condition Here there is a distinct probability that the pelag fisheries of south-eastern Australia will develop west- rather than on east-Pacific lines. From t unusually large number of rare circumtropical a sub-tropical species in 1939–40 and from the simu taneous reduction in number of the more indigeno species, abnormally warm conditions apparently pr vailed during that period, along with a progressi decline in the volume of plankton from 1939 onwar —conditions which adversely affected the fisheries.

The plankton, including the Tunicata, is mu more concentrated in the upper 50–100-metre wat layers than at greater depths, and several times mo concentrated in the warmer than in the colder mont of the year. Lesser and more uniform concentratio occur at greater depths. This affords some explan tion of the surface shoaling of pelagic fishes a indicates that future investigations will yield mo reliable results and be most economically pursued chiefly inclined to the upper water layers in t warmer seasons of the year.

Of the pelagic salps of south-eastern Australi *Thalia democratica* is by far the most characteristi the next being *Ihlea magelhanica*, and thirdly *Sal fusiformis*. Among the Copelata the outstandi species is *Oikopleura longicaudata*. The young colonies of *Pyrosoma atlantica* are extremely abunda at times. A list of the species so far found in sout eastern Australian waters is given, but systemat and general data with keys to identification a reserved for a separate publication.

The study of the Australian mullet fishery relat chiefly to *Mugil dobula*, probably the most importa of the inshore species. The result of the work show there is undoubtedly over-fishing and that mo restrictions should be placed upon the operatives the industry in order that the stocks may be allowe to recover and possibly improve beyond earlier level A scheme for immediate and future action to secu restoration of the fishery is submitted.

The mullet fishery operates along almost the enti coast of Australia. There is a two-phase fishery *Mugil dobula* which spends the greater part of t year in rivers and lakes and a few months in movin in truly marine water in shoals along the coast spawning migrations. It is found by tagging exper ments that the river and lake fish are not, as t fishermen supposed, distinct from those in the se

* Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 153: Pelagic Tunicates in the Plankton of Southeastern Australian Waters and their Place in Oceanographic Studies. By Dr. Harold Thompson; with a Statistical Analysis of Data on Total Plankton, by G. L. Kesteven. (Division of Fisheries, Report No. 8.) Pp. 56+1 plate. Bulletin No. 157: Studies in the Biology of Australian Mullet, 1: Account of the Fishery and Preliminary Statement of the Biology of *Mugil dobula* Gunther. By G. L. Kesteven. (Division of Fisheries, Report No. 9.) Pp. 147+2 plates. (Melbourne: Government Printer, 1942.)

but merely different phases of one life-history, the lake fish being slimy and dark and the sea fish clean and shining blue. On the east coast there is a continuous movement from the southern rivers into those north of them, and there must be recruitment from the north as there are apparently no separate races, and there is probably one intermingling stock. Thus the problem is one for a single uniform policy.

The mullet is a bottom feeder and eats the sandy and muddy slime of the fresh and brackish waters, taking in the organic substances in it. Presumably, feeding ceases when the fish move to the sea. The larval development is unknown, but there are reasons to believe that the egg is pelagic and hatches within a short period, spawning probably occurring at or near the mouths of the estuaries in the surf zone. The young fish are still within a few miles of the estuary at the end of the first year, but after that they move farther up the rivers or lakes and spend their second and third year there.

NEW ZEALAND EARTHQUAKES DURING 1941

ACCORDING to the report on seismology for the year ended December 31, 1941, which has recently been received from the acting director, R. C. Hayes, the total number of earthquakes reported felt in New Zealand during 1941 was 107, the smallest number in any year since 1928 (Dominion Observatory Bulletin No. R.27, extracted from the Annual Report of the Department of Scientific and Industrial Research, 1941–42, Dominion Observatory, Wellington, New Zealand). The earthquakes, in addition to being reported by numerous individuals as having been felt, were recorded by instruments as follow, the situation of the instrument being given first, and the type of instrument in parenthesis afterwards: Auckland (Milne-Shaw), Arapuni (Milne), Rotorua (Jaggar), Tuai (Wood-Anderson), New Plymouth (Wood-Anderson), Hastings (Jaggar), Bunnythorpe (Jaggar), Wellington Central Station (Galitzin-Wilip, Milne-Shaw, Wood-Anderson, Jones, Imamura), Takaka (Imamura), Greymouth (Jaggar), Christchurch (Galitzin three components, Wood-Anderson), and Monowai (Jaggar). Milne-Shaw seismograph No. 36 was installed at the Auckland Museum early in April. However, it was not until November that the necessary apparatus was obtained for maintaining accurate time. There was considerable delay in establishing a Wood-Anderson seismograph at Kaimata near Greymouth owing to the war, but some progress has been made. The public works officials at Rotorua have developed a method of obtaining records on blueprint paper instead of on smoked cardboard. The seismograph at Chatham Islands has been temporarily suspended owing to the War.

Of the 107 shocks in 1941, 61 were felt in some part of the North Island and 55 in some part of the South Island. Nine were felt in both Islands. The maximum intensity reported felt was Rossi-Forel (*R.F.*) 8. Although the number of shocks felt was small, seismograph records indicate that minor activity was much the same as in previous years. Earthquakes were comparatively frequent in the far north-eastern part of the North Island and in the central districts; and there was more activity than usual in Canterbury. On the other hand, most of Hawke's Bay was comparatively free from earthquakes. Occasional shocks originated in the far south-west. The only two outstanding seismic events occurred early in the year. These were (1) a shock of *R.F.*8 originating near Taneatua, in the Bay of Plenty, on January 9; and (2) one of *R.F.* 6–7 near Lake Coleridge, in Canterbury, on February 7. The Taneatua shock was of very shallow origin, and in spite of the high intensity in the epicentral region the maximum radius of the 'felt' area did not exceed 70 miles. The Lake Coleridge shock was of normal depth and its 'felt' area was also small (maximum radius about 100 miles). After-shocks of the Lake Coleridge disturbance continued at intervals throughout the remainder of the year. Both these earthquakes were approximately 5 on the instrumental magnitude scale. Other shocks with *R.F.* intensity 6 or greater than 6 were: April 6d. 18h. 46·8m. U.T. from Taumarunui and Hastings to Queenstown and Dunedin (6), May 29d. 11h. 17·1m. U.T. parts of southern Hawke's Bay (6+), August 10d. 10h. 05·2m. U.T. Southland, parts of Otago (6), and September 24d. 11h. 39·5m. U.T. Opotiki to Wanganui and Waipawa (6). Four further shocks had scale 5 or rather greater, and one had scale 3 intensity.

Two notable features of the 1941 results were: (1) a prevailing tendency for activity to be concentrated towards the north-western side of the general seismic region; and (2) the occurrence of shocks slightly deeper than normal in the submarine region between Taranaki and Nelson and beneath the northern part of the South Island. This has been confirmed by a recent revision of the earthquake records of previous years.

NUTRITION IN RELATION TO BONE GROWTH AND THE NERVOUS SYSTEM*

THE problem had its origin in observations made in 1918, when an experimental study of rickets was in progress. Some of the animals developed severe inco-ordination of movement, independently of rickets, and the condition clearly involved a different etiological factor. The latter differentiation of the anti-rachitic vitamin from vitamin A made it possible to show that the inco-ordination of movement in young animals was due to vitamin A deficiency.

Examination of the peripheral and central nervous system revealed widespread degeneration of afferent nerves (cranial and spinal) and ascending fibres in the central nervous system. The interpretation of the results at this period was that vitamin A deficiency produced degenerative changes in most nerve cells of afferent and ascending nerves, but left those of the descending and efferent nerves intact. Here the position was left for some years, but the unsatisfactory nature of the explanation impelled a return to the investigation. Since the 8th nerve was obviously particularly affected, serial sections of the labyrinthine capsules were studied. This examination led to the finding of abnormal bone growth in the internal auditory meatus, which was clearly pressing on both divisions of the 8th nerve. A similar overgrowth of periosteal bone was found to explain destruction of other peripheral afferent nerves. Many other abnormalities of the nervous system resulted from the same cause, including deformity of the cerebellum and medulla, increased intracranial pressure, internal hydrocephalus, reduction of the subarachnoid space and of the cerebrospinal fluid, and the squeezing of the whole of the central nervous system in its bony covering.

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* Substance of the Croonian Lecture delivered by Sir Edward Mellanby, K.C.B., F.R.S., before the Royal Society on July 15.

The investigation had now come back to its starting point, namely, bone development, since it was obvious that the essential problem, although associated with such drastic nervous defects, was largely one of abnormal bone growth. In the absence of vitamin A and carotene, bone growth in certain positions was excessive. Whereas it was shown in the earlier work that the antirachitic vitamin (now vitamin D) controlled the hardening of bone, it was now evident that vitamin A restrained the bone cell elements in some way, so that in its absence there was loss of normal bone shape and also of co-ordination of its growth in relation to that of the enclosed central nervous system. Although many of the essential facts of the relation of vitamin A to bone morphogenesis are still unknown, some recent results on this problem were described.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Saturday, July 24

Institute of Physics (Midland Branch) (at the University, Edmund Street, Birmingham), at 2.30 p.m.—Lectures by Prof. R. Peierls and Dr. L. Jánossy on "The Meson".*

Wednesday, July 28

Zoological Society of London (in the Meeting Room, Regent's Park, London, N.W.8), at 3 p.m.—Sir John Graham Kerr, F.R.S.: "A Naturalist in the Gran Chaco, South America".*

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Assistant Master or Mistress to teach mainly General Science in the Junior Technical Schools, Bath Technical College—The Director of Education, Education Department, Guildhall, Bath (July 30).

Johnston Chair of Biochemistry—The Registrar, The University, Liverpool (July 31).

Lecturer in the Department of Chemistry—The Principal, Derby Technical College, Normanton Road, Derby (July 31).

Veterinary Inspectors (temporary) in the Ministry of Agriculture and Fisheries—The Ministry of Labour and National Service, Central (Technical and Scientific) Register (Reference No. ONF. 1399), Alexandra House, Kingsway, London, W.C.2 (August 2).

Demonstrator (male or female) in Anatomy—The Registrar, The University, Sheffield (August 2).

Speech Therapist—The Secretary to the Chesterfield and Mansfield Education Committees, Education Offices, Mansfield (August 3).

Head of the Building Department—The Registrar, Technical College, Sunderland (August 6).

Lecturer (man) in Science (Physics and Chemistry)—The Principal, Borough Road College, Isleworth, Middlesex.

Teacher of Engineering Workshop Practice in the Smethwick Junior Technical School—The Chief Education Officer, Education Offices, 215 High Street, Smethwick 41.

Science Master to teach mainly Biology in connexion with a Pre-Agricultural Course for Boys at the Maidstone Technical Institute—The District Secretary, Kent Education Committee, 13 Tonbridge Road, Maidstone.

Research Chemists, Physicists and Fuel Technologists for research and development work in connexion with the Ceramic Industry—The Director of Research, British Pottery Research Association, Queens Road, Penkhull, Stoke-on-Trent.

Lecturer in the Mathematics Department—The Principal, Heriot-Watt College, Edinburgh.

Visiting Lecturer in Psychology—Tne Secretary, King's College of Household and Social Science, c/o University College, Leicester.

REPORTS and other PUBLICATION

(not included in the monthly Books Supplement)

Great Britain and Ireland

Education and Training for Engineers. Pp. ii+22. (Londo Institution of Electrical Engineers.) [2

Geological Survey of Great Britain: Scotland. Wartime Pamph No. 34: Commercial Mica in Scotland. Part 1: Characteristics Commercial Mica. By Dr. W. Q. Kennedy. Pp. 14. (London: Ge logical Survey and Museum.) 9*d*. [2

Lister Institute of Preventive Medicine. Report of the Govern Body, 1943. Pp. 24. (London: Lister Institute.) [2

Association of Polish University Professors and Lecturers in Gre Britain. Professor Bronislaw Malinowski: an Account of the Memor Meeting held at the Royal Institution in London on July 13th, 194 Pp. 24. (London: Oxford University Press.) 1*s*. net. [2

The British Council. Report for 1942–1943. Pp. 108. (Londo British Council.) [3

Colonial Office. Labour Supervision in the Colonial Empire, 193 1943. (Colonial No. 185.) Pp. ii+26. (London: H.M. Statione Office.) 6*d*. net. [1

Abstracts of Dissertations approved for the Ph.D., M.Sc., a M.Litt. Degrees in the University of Cambridge during the Academic Year 1941–1942. Pp. 72. (Cambridge: At the University Press.) [1

Ministry of Fuel and Power: Committee on the Efficient Use Fuel. Fuel Efficiency Bulletin No. 20: Cooling Firebars in Industri Furnaces and Boilers. (F.E.C.172.) Pp. 12. (London: Ministry Fuel and Power.) [1

The Farm Tractor. Pp. 40. (York: National Institute of Agricu tural Engineering.) 9*d*. [13

W.E.A. Educational Pamphlets. No. 1: Plan for Education; Programme of Educational Reconstruction. Pp. 34. 6*d*. No. The Education and Training of Teachers; a Memorandum submitt in Evidence to the Departmental Committee under the Chairmansh of Dr. A. D. McNair by the Workers' Educational Association. P 20. 6*d*. No. 4: Agriculture and Rural Education; a Statemen submitted to Mr. Justice Luxmoore's Committee. Pp. 22. 6*d*. (Lo don: Workers' Educational Association.) [13

Other Countries

Ministry of Public Works, Egypt: Physical Department. Physic Department Paper No. 44: Notes on the Flow of Viscous Fluids; Series of Six Notes presenting New Lines of Approach to Vario Aspects of Fluid Motion, mainly with reference to the Flow of Wate By A. Fathy, Dr. S. Bishara and S. A. M. Hassanein. Pp. xi+9 (Cairo: Government Press.) [25

Commonwealth of Australia: Council for Scientific and Industri Research. Bulletin No. 154: The Handling and Storage of Australia Oranges, Mandarins, and Grapefruit. Compiled by Dr. F. E. Hueli (Report of Investigations carried out under the direction of the Citr Preservation Technical Committee from 1935 to 1941.) Pp. 60+ plates. Bulletin No. 156: Standardized Plant Names; a List Standard Common Names for the More Important Australian Grasse other Pasture Plants, and Weeds. Pp. 99. (Melbourne: Gover ment Printer.) [28

Brooklyn Botanic Garden Record. Vol. 32, No. 2: Thirty-secon Annual Report of the Brooklyn Botanic Garden, 1942. Pp. viii+43 164. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) [13

Jamaica. Annual Report of Forest Division, Department of Agr culture, for Year ending March 31st, 1942 (Abbreviated Report). P 8. (Kingston: Department of Agriculture.) [13

Bulletin of the Experiment Station of the Hawaiian Sugar Planter Association. Entomological Series, Bulletin No. 22: The Coccinellid or Ladybeetles of the Koebele Collection, Part 1. By P. H. Timberlak Pp. 67. (Honolulu: Hawaiian Sugar Planters' Association.) [13

U.S. Department of Agriculture. Circular No. 671: Samplin Technique for Determining Populations of the Citrus Red Mite an its Predators. By Chas. F. Henderson and Horace V. McBurnie. P 12. 5 cents. Farmers' Bulletin No. 1930: Prevention and Contr of Alfalfa Weevil Damage. By J. C. Hamlin, W. C. McDuffie an F. V. Lieberman, and R. W. Bunn. Pp. ii+14. 5 cents. Leafle No. 226: The Pepper Weevil. By J. C. Elmore. Pp. 8. (Washingto D.C.: Government Printing Office.) [13

Annals of the New York Academy of Sciences. Vol. 44, Art. 1 Boundary-Layer Problems in the Atmosphere and Ocean. By C.- Rossby, B. Haurwitz, Benjamin Holzman, Woodrow C. Jacobs, A. Kalinske, Phillip Light, R. B. Montgomery and H. U. Sverdrup. P 104. (New York: New York Academy of Sciences.) [13

Cornell University Agricultural Experiment Station. Bulletin 786 Population Trends in New York State, 1900 to 1940. By W. A. Ande son. Pp. 72. Bulletin 787: Effects of Daylength and Temperatu on Growth and Flowering of some Florist Crops. By Kenneth Pos Pp. 70. Bulletin 788: Fusarium Wilt of Carnations caused *Fusarium Dianthi* Prill. et Del. By J. M. Bickerton. Pp. 32. Bullet 789: Soil and Field-Crop Management for the Catskill-Mohawk Are of New York. By A. F. Gustafson. Pp. 32. Memoir 248: Studi with Silver Compounds and Mixtures as Fungicidal Sprays. B Lowell W. Nielsen. Pp. 44. Memoir 249: The Effect of Vario Diluters, Cooling Rate, Temperature of Storage, and some oth Factors, on the Livability of Spermatozoa in Stored Samples of B Semen. By E. L. Willett and G. W. Salisbury. Pp. 46. (Ithaca, N.Y. Cornell University Agricultural Experiment Station.) [1

Catalogue

Scientific and Medical Books, with an Interesting Collection Newtoniana and many Items of General Interest. (Catalogue N.S. 52. Pp. 36. (London: Wm. Dawson and Sons, Ltd.)

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RECONSTRUCTION OF LOCAL GOVERNMENT

IN the attention which is already being directed to the varied problems of reconstruction which we must be prepared to face in the post-war world, the significance of one fundamental group of problems which impinges on all the rest is rarely adequately stressed. Whether we are considering problems of social security and the means of implementing the proposals of the Beveridge Report, those of national health, of education, of the utilization of the land and its resources, or of trade and employment, the development or evolution of democratic institutions to serve the changing needs of our society is of critical importance. The nature and structure of the central government, its relations to local and representative institutions, the training and recruitment of the staff by which effect is to be given to the Government's policy, the place of scientific method and of the technical expert in the government machine—these are all aspects of the machinery of government which require careful study. In the light of that examination we can approach the central problem of developing a new society in which the essential measure of central planning is to be ensured while preserving the freedom of enterprise and the individual initiative and vigour which have been the secret of so much of the greatness of Great Britain in the past.

Attention is already being directed to a number of these problems by the Government. A committee of Ministers and an interdepartmental committee of permanent heads of departments is understood to be at work considering, *inter alia*, the machinery of government, and another committee has now been appointed under the chairmanship of the Financial Secretary to the Treasury to examine the general question of the training of Civil servants. Experience in civil defence and a succession of reports such as the Scott and Uthwatt Reports are enforcing reconsideration of the question of regionalism and the size of the local government units to make planning in war and in peace effective. While the democratic system of Great Britain implies the supremacy of a national government in which the interests of the parts are woven into the over-riding interests of the whole, central government cannot be successful or other than tyrannous unless the interests of the parts are maintained.

Few things show more clearly the weakness of the existing local government system of Great Britain than that it should now, after eleven years, be necessary to pass special legislation to bring under planning control "land which is not subject to a scheme or resolution under the Town and Planning Act of 1932". The duties of local authorities with regard to post-war planning will be vital and, if the main proposals of the Scott and Uthwatt Reports are enacted, will be such that they cannot avoid them. It is essential, therefore, that every effort should be made to ensure that the structure and machinery of local government is administratively sound and served with vigour and with vision—that it fulfils its vital function of bringing to the national machinery of government the local knowledge, the personal element and responsibility which are essential if our institutions are to remain democratic and representative as well as efficient.

The structure and reform of local government have now been considered in at least three reports. That of the General Purposes Committee of the Association of Municipal Corporations on the re-organization of local government was adopted by a general meeting of the Association in London, and its recommendations have now been submitted for consideration by Sir William Jowitt's Committee on Reconstruction. A report on the "Future of Local Government" has since been published by the Labour Party, while the National Association of Local Government Officers has issued, as an expert contribution to the problems of the future of local government, an interim report on the reform of local government structure prepared by an independent committee of local government officers. The general similarity both of the conclusions of these reports as to the weaknesses of the present system and of the recommendations for reform is very striking.

The Labour Party's report and those of the Association of Municipal Corporations and the National Association of Local Government Officers remark that there are too many local authorities in Great Britain, and that the majority are too small to tackle problems of post-war reconstruction. The standard of social services is very unequal; and an undesirable distinction between town and country is made by the present structure. The National Association of Local Government Officers also emphasizes the need for securing better co-operation between local government areas in such matters as education, medical services, milk supply, highways and libraries. Either the structure of local government must be drastically amended, or an undesirable degree of control by the central government will be necessary.

As a first step it is recommended that the Government should at once set up a Local Government Boundary Commission to survey the whole of England and Wales and recommend such changes in local government boundaries as are desirable. This Commission should be a permanent body and should be constituted the tribunal for the consideration of all matters affecting local government boundaries in the future.

The importance, in any change in local government, of fusing the interests of town and country so that within each major unit there is a well-balanced grouping, actual or potential, of diversified industry, agriculture, commerce and residence is recognized by the Association of Municipal Corporations, whereas it advocates that such services as gas, transport and electricity should be part of a national scheme under public ownership, with a proper locus for local authorities in regard to prices and services. The difference between these proposals and those of the National Association of Local Government Officers appears, in fact, to be superficial rather than fundamental, and although the Labour Party's report does not specify in detail the size or area of the units to be adopted, it appears improbable that they would differ significantly from those of the all-purpose authorities advocated by the other reports.

These three reports agree in making an attempt to meet that need for greater opportunities for personal contacts between all grades of society, and machinery for fuller exchange of views and interests between them which are such important factors in the method of discussion that is the essence of a democratic system. The importance of the personal factor cannot well be overstressed. The contacts established through the War have already had a loosening and educating influence on the social structure, and we must look to this process to overcome the opposition to change as such which has already manifested itself, even in the Association of Municipal Corporations, particularly on the part of the small units which fear the loss of either power or individuality.

Two points are of fundamental importance. To the local authority we must look in large measure for the redress of the balance against any bureaucratic tendencies which may be inherent in the large-scale measures of planning which are as inevitable in post-war reconstruction as in the development of our full war effort. That objective can only be secured when we are able to obtain the services of the right type of men and women for the local authorities. The very best and not the mediocre, indifferent or self-seeker must be attracted to the local councils, and any obstacles to such enlistment must be removed as fully as possible. Local government authorities must be given the dignity and status to make that appeal. They must also prove that they deserve such dignity and status by the vision, the wisdom and the magnanimity with which they address themselves to the problems confronting them. Independence of mind, sound and disinterested judgment, rather than party allegiance, must be the hallmark of the local councillor if our democracy is to preserve its vital character and serve the new age.

The solution of that problem may well offer some assistance in the solution of a further problem, as important in local government as in the national sphere—that of the place of the scientific or technical expert. The problem is in some respects not dissimilar from that of the control of industry and of its relations to the State, and the fundamental thinking and inquiry which offer a solution to the one problem may well be found to have a profound bearing on the other two.

It is at this point that Prof. Ernest Barker's great work, "Reflections on Government", renders such valuable service. Unless we clearly understand what is involved in a democratic system, the way in which government depends on the mutual exchange of ideas, on mutual criticism of the ideas exchanged, and on the common and agreed choice of the idea which emerges from the ordeal of interchange and criticism, we may well advance proposals which destroy the essential balance of forces and the spiritual quality of the processes on which the democratic system depends. That danger is patent from the most cursory reading of the numerous proposals for reconstruction which have been advanced by industrial organizations, trade associations, and Chambers of Commerce, the Unilever paper "The Problem of Unemployment" being a conspicuous exception; and it cannot seriously be maintained that professional associations, albeit unconsciously, are likely to be free from fault in this respect.

It is the besetting danger of professional associations that such organization tends in time to become conservative and directed towards self-preservation rather than seeking the public good, no matter how gradual the stages by which the initial pioneering and reforming spirit is sloughed off. Against that danger professional men can and should be on their guard, and the report of the National Association of Local Government Officers, like that of the Institution of Municipal and County Engineers on Post-War Planning and Reconstruction and the earlier report of a joint committee of local sections of the Society of Chemical Industry, the Royal Institute of Chemistry and the Chemical Society to the District Commissioners for Depressed Areas in 1935, is an admirable example of the way professional associations do in practice make valuable corporate contributions to the discussion of public affairs. That difficulty is inherent in the nature of a professional association, and even from the point of view of the advancement of professional knowledge, one of the major problems is to secure that the governing body or council is sufficiently receptive and responsive to new ideas, while preserving the standards and tradition of the profession.

There is, however, a second difficulty which is important. Dr. Barker's analysis here deserves the careful consideration of the scientific worker. Within his sphere the expert has clearly the duty, as well as the right, to speak. Information, however authoritative in regard to any particular field, must, as Dr. Barker points out, necessarily be compared with, and adjusted to, information in regard to other fields. There is no issue in politics which falls within one field and one only. A like proposition might be advanced of industry. It is only in the procedure of science that particular fields are abstracted and isolated for inquiry. Moreover, information furnished by the expert in regard to his field, or by a number of different experts in regard to their different fields, is information which touches only the actual body of knowledge in the field or fields concerned. By its nature it is confined, on the whole and in the main, to measurable data. It cannot solve and is not intended to solve the problems of action, though it may set limits to action, and in that sense and to that extent determine action.

We must therefore recognize that, as Dr. Barker rightly insists, the solution of the problems of action in social and political life depends on more than scientific measurement and the results of such measurement. It depends also on the process by which different claims of right and acknowledgments of duty, which must be made sufficiently commensurable to be adjusted to one another, are set to give information about themselves, and in so doing, to reconcile themselves to one another in the certainty of a uniform and accepted law. The services of the scientific expert, as such, are thus limited to advice on the limits of action or the measurable factors involved in action, not on the action or on policy itself.

For this reason the conception of a planned State managed by experts in the art of production is alien to the mental assumptions and preconceptions on which the life of the modern State has come to proceed. For the same reason, the idea of self-government of industry is an illusion to be firmly rejected, as Mr. Herbert Morrison indicates, though not entirely for his reasons. A much closer integration of industry with the structure of society is required and, as Dr. Barker points out, and as C. E. Purdom illustrated in his suggestive book "The New Order", the solution to the problem of the relations of business and professional enterprise to the State may lie rather in the adoption, not by the State of the methods of business and industry, but by business of the methods of open discussion and voluntary agreement which have been so highly developed in the State.

The importance of regionalism in this connexion is the possibility it offers, as developments during the War have shown, of tapping more effectively the immense reserve of devoted service, initiative and capacity of leadership which had not previously been enlisted by the organs of local government and which for various reasons is unlikely to find an outlet in national politics. To utilize this material, larger units and wider powers and responsibilities in local government are essential, and a machinery in which sound administrative principles are embodied with the flexibility and adaptability required to serve the changing needs of the times. Secondly, and equally important, by integrating at the local and regional level the knowledge and services of the professional or scientific expert, it should assist in that important work of educating not only the electorate but also the councillors and others who are called upon to act on the recommendations of expert commissions in special fields.

Dr. Barker makes the point that there is a profound sense in which the process of democracy is itself scientific, and the method of procedure by inquiry, whether by Royal Commission as the Barlow Commission, or special committee as the Scott and Uthwatt Committees, is essentially scientific. Procedure by genuine discussion, starting from an adequate knowledge of the relevant facts, and proceeding, by an adequate assessment of the significance of the different data, to action based on that knowledge, bringing one claim of right into argument with another, and eliciting acknowledgments of duty to meet and face claims of right, inducing men to make for themselves compromises between different claims, and to achieve for themselves a union and a correspondence between rights claimed and duties acknowledged—this is true not only to the ideal of democracy but also to that of scientific government. The reason why, when strengthening the general method by adding the particular machinery of expert scientific commissions, the results have been disappointing, is that we have failed to carry the process of integration and discussion to low enough levels. We have not met sufficiently fully the intensely searching demands which the complex problems of to-day make not only on the machinery of government but also on the men responsible for running the machine and the ordinary citizens whose interests it is designed to serve.

This problem of education is, in fact, the key problem. Until it is met, and the allied problem of improving the machinery of discussion at all levels, we cannot secure the essential integration and the balance which the efficient functioning of a democratic system requires. Without it the adjustment of economic claims and counter-claims, for example, can only be very imperfectly achieved at a stage preceding action by the State. The self-discipline and self-planning which are as important as State planning and State discipline also depend on an educated order, and if Dr. Barker is right in holding that the expert bodies in industry and economics or in other special fields should be advisory and consultative, they can only function efficiently when this condition is fulfilled.

Planning in a democracy is necessary, but it must be compatible with the liberty of a general society of free minds. In ensuring that condition, local government has a vital part to play. The proposals advanced in these reports for strengthening local government to meet the new conditions have a strong claim on the interest of scientific men, who should be stimulated to take their full share individually in such work, and individually and collectively in the thinking that has yet to be done to modify or strengthen our political institutions where needed to ensure that in the new order the essential human freedoms are served with all the knowledge and experience which science can bring to bear.

TIME BASE CIRCUITS

Time Bases (Scanning Generators)

Their Design and Development; with Notes on the Cathode Ray Tube. By O. S. Puckle. Pp. xii+204+5 plates. (London: Chapman and Hall, Ltd., 1943.) 16*s*. net.

THE cathode-ray tube has found its chief application, in the hands of the research worker, in connexion with the study of the time-variation of voltages and currents. In such applications, the quantity under observation produces a deflexion of the spot on the screen of the tube, usually in a vertical direction, while the application of a steadily changing voltage makes the spot move in a perpendicular direction. The resultant movement of the spot traces out a Cartesian graph of the variation with time of the quantity being studied.

The circuits producing the steadily changing voltage which makes the spot execute the 'time-axis' or 'time base' have been called 'time base circuits' or, more shortly, 'time bases'.

The book under review deals with the design and properties of circuits which have been developed, both for this purpose and for the similar object o making the spot traverse or *scan* the screen of th cathode ray tube in connexion with television. I the latter application the circuits are sometime called scanning generators—the name adopted as part of the title of the book.

The requirements of these two applications diffe only in that, in the case of the television circuits stress is laid on simplicity coupled with a speed o traverse the irregularities of which are inappreciabl to the viewer, whereas in the 'research' circuits simplicity is not so important.

The majority of time-bases depend on the exponential rate of charge or discharge of a condense which is in series with a resistance and a source o electromotive force, the periodic charge (producing the working stroke of the traverse) and discharge (producing the fly-back) being effected by an electronic switch or 'trigger circuit', which is usually a type of 'relaxation oscillator'. The action of the trigger circuit is often initiated by a 'synchronizing' or 'locking' impulse in order that the time base may start at a desired instant. The output from the time base circuit may not be sufficiently linear, that is, the speed of movement of the spot may not be sufficiently constant. To cure this defect 'linearizing' circuits are added. Further, the output may be insufficient in amplitude or unsuitable in form, and may cause aberrations in the trace on the cathode ray tube. Properly designed amplifier stages may be used to overcome these troubles.

Information on the design of time bases is scattered throughout reports on electrical, medical and other research, being often mentioned in passing, as a detail of the equipment used, and therefore difficult to find. The author has performed a very useful service in collecting, in one book, a large amount of material on time bases (accompanied by clear exposition and by criticism), to which he has added some account of his own work in certain aspects of the subject.

Some idea of the scope of the book may be gained from the following summary.

After classifying the different types of time base the author shortly disposes of the simple time bases produced by a sinusoidal source and devotes the rest of the book to the (ideally) 'linear' time base, in which the velocity of the spot is constant. As mentioned above, the movement of the spot is usually caused by an exponential voltage charge. The author, in a chapter entitled "Linearization of the Trace", describes certain artifices which make the rate of movement of the spot more constant. This chapter is prefaced by a discussion and definition of linearity, and includes an ingenious circuit in which feed-back increases the degree of linearity to an extent equal to the stage-gain of the valve. A chapter devoted to trigger circuits which control the operation of the time base condenser describes circuits such as the transitron, 'flip-flop', and Schmitt's trigger circuit (a variant of a circuit described by G. T. Evans in 1931).

The importance of applying the time-base-producing voltages symmetrically to the cathode ray tube is described in a chapter on push-pull deflexion, and the book ends with a description of methods of synchronizing or locking time bases to the frequency of occurrence of the phenomena under observation and with a note on the use of time base circuits for frequency division—a by-product of their usual application.

Some useful appendixes are added, dealing (among other things) with practical notes on the use of a cathode ray tube, linearity of exponential variations, the author's work in clearing up certain anomalies in the operation of gas-discharge valves, 'differentiating' circuits, and square wave generation (including the use of an artificial line for producing brief pulses).

A full table of contents, the clearness of which is enhanced by the use of four different type faces, a short bibliography and an index are included. The circuit diagrams which accompany the descriptions are numerous and clear.

The reviewer, while realizing that an author in war-time is subject to limitations of paper supply, thinks that the value of the book might be enhanced by certain additions. First: the author's standing in the 'time base' world fits him well for producing an authoritative glossary, which would include words such as scan, trace, firing, locking, square pulse, etc. Secondly: in his outline of the action of the multivibrator, the author adheres to the usual description, in which the back-coupling between the two valves produces a 'cumulative' effect which leads to instability. This simple description would lead to the idea that back-coupling *per se* leads to instability, whereas a gain 'round the circuit' greater than unity is a necessary condition. A more satisfying explanation is that the circuit (at first stable) is caused to arrive at such a condition that the gain is greater than unity, and instability results. A more comprehensive account, in terms of positive feed-back, is given in the chapter on trigger circuits. Thirdly: the author illustrates some descriptions with "Cyclograms" which show the path of the spot resulting from the simultaneous application of two voltages to the two deflecting systems. The time-variation can be inferred qualitatively by studying the relative thickening of the slowly moving traces, but the reviewer suggests that this information could, with advantage, be introduced quantitatively by modulating the beam by means of a square wave of known frequency.

L. BAINBRIDGE-BELL.

PLANT GEOGRAPHY OF THE MEDITERRANEAN REGION

Das Pflanzenkleid der Mittelmeerländer

Von Prof. Dr. M. Rikli. Lief. 1. Pp. 128+17 plates. 7.50 francs. Lief. 2. Pp. 129–240+17 plates. (Bern: Hans Huber, 1942.) 9 francs.

IN view of the importance of the Mediterranean region as the centre of origin of a great number of cultivated plants (Vavilov, *Trudy prikl. Bot. Leningrad*, 16, No. 2, 242; 1926) and of its interest to botanists and agriculturists in South Africa, parts of Australia, California and other localities where somewhat similar climatic conditions prevail, a detailed, documented account of Mediterranean plant geography such as that now being published by Prof. M. Rikli, of Zurich, himself a specialist in the subject, is much to be welcomed.

The work is appearing in serial parts containing approximately 120 pages. Two parts have been received in Great Britain. Although unfortunately no prospectus showing the ultimate extent of the book is to hand, a study of the existing fascicles sufficiently indicates its indispensable nature for the library of the botanist and the ecologist.

The matter treated in the first two parts comprises a definition of the Mediterranean region and its limits, with some reference to transitional zones; its climatic conditions; the life-forms of the Mediterranean flora and their phenology; and the beginnings of a classified account of the flora itself. One chapter is devoted entirely to a study of the olive tree, described as not only the most valuable tree of the region economically, but also the principal indicator of typical Mediterranean conditions, for where the olive tree ceases to appear, there is the boundary of the true Mediterranean flora. The seventh chapter, of which only a part (pp. 168–240) is included in the issues under notice, deals with the natural land of the region, treating first six groups of formations found in land capable of cultivation but not yet under culture. These groups are the forest, large and small shrub and rock gorge formations, and the less important marsh and strand formations.

In defining the Mediterranean region, three main divisions are recognized: (1) North Africa, comprising the Atlas countries (Morocco, Algeria, Tunisia) and the Barka countries (Tripolitania, Cyrenaica, Marmarika and Egypt); (2) southern Europe; and (3) near Asia. The last-named section is again divided into Orient I (Asia Minor, Cyprus, Syria, Palestine, Sinai Peninsula) and Orient II (the Caucasus countries; Ciscaucasia and Transcaucasia, part of Armenia, the southern shore of the Caspian). Orient III (Arabia, Mesopotamia, Iran, Irak, etc.) lies outside the region under consideration. An imaginary line dividing east from west runs from Trieste down through the Adriatic and Mediterranean east of Malta and crosses the African coast at the Tunisian-Tripolitanian frontier: it is noted, however, that this division is of an arbitrary nature, while on the north and south the region is fairly sharply defined by natural frontiers, namely, mountain ranges and deserts. The eastern limits of the region are the most debatable; but, although the Caucasus lands and the northern shores of the Black Sea no longer exhibit much of the typical Mediterranean flora, it is considered that they should be included in the region, as the Black Sea forms actually a part of the Mediterranean Sea, while the Caspian Sea was in geologically recent times in connexion with the Black Sea and thereby with the Mediterranean also. At the same time, the relativity of any plant geographical limits is stressed, and attention is directed to the marked contrast of the eastern part of the region, with its more continental climate and rainfall lower than in other parts of the Mediterranean, to the extreme west, where the climate is maritime and characterized by humidity and very abundant rainfall.

Of great importance for the especial character of the flora is the annual rainfall and its seasonal distribution. On the whole, the amount of the annual rainfall diminishes steadily from north to south, and, for the same latitude, from west to east. The actual quantities are not so low as the character of the vegetation might suggest—the mean figure given is indeed 9·3 per cent higher than that for Germany—but the greater warmth and drier air of the Mediterranean region, together with the drought-hardened soils, greatly increase the proportion of evaporation and run-off and reduce that of the moisture available to the plants. Seasonal distribution, however, is the weightiest factor governing the preponderantly xerophilous nature of the Mediterranean flora, for during the summer there is little or no rainfall, so that this season constitutes for the plants a season of rest. Atmospheric humidity, like the amount of rainfall, also diminishes from north to south and from west to east; and especially in summer, at the time of the greatest evaporation, the air is extraordinarily dry. Rainfall is generally of a torrential nature and of short duration. The temperature of the Mediterranean region is distinguished by a remarkable degree of uniformity, by high winter temperatures and generally very moderate minima, the average minima ranging from + 7·3° C. at Alexandria to −7·2° C. at Montpellier. Winds, general and local, the light climate—described as a "photochemical climate" akin to the intensity recorded for alpine heights—and the microclimate have also their part in conditioning the special nature of the Mediterranean flora. These life conditions are fully dealt with in Chapter 4.

While the great majority of the Mediterranean plant types, differing so greatly in habit, can be described as xerophytes, the following fifteen groups are distinguished and described: therophytes, geophytes, sclerophyllous plants, compass plants, trichophytes, secretory plants, armoured plants, microphyllous plants, virgate plants (Genista spp., *Spartium junceum*, etc.), thorn bush (thorns constituting an adaptation to drought and great intensity of light rather than a protection from animals), chamæphytes and hemicryptophytes, cushion plants, xerophytic Gramineæ, succulents, osmophytes.

The portion of the seventh chapter now at hand contains the section on the natural forests of the Mediterranean region—mainly oak, notoriously sparse and composing only 10–30 per cent of the total area—and a part of the section on the woods and large bush formations. Of particular interest, perhaps, is the account (pp. 221–236) of the widespread Mediterranean evergreen formation, the maquis. There are discussed its origin, its botanical composition, the conditions governing its existence and the modifications and displacements brought about through human activity and especially through large-scale burning for pasture. From personal observations in Corsica, it is estimated that the greater part of the evergreen bush of that island is burnt on an average once every six to ten years, "an expression of the age-long strife between the pastoral population, which desires to enlarge its grazing areas, and the forester".

The section on the pseudo-maquis, a more winter-hardy xerophytic evergreen bush formation occupying montane and submontane regions, is as yet incomplete.

References to the literature are placed at the end of chapters, and the work is copiously illustrated by maps and photographs. G. M. ROSEVEARE.

ROTATION AND THE PLOUGH

The Way of the Land

By Sir George Stapledon. Pp. 276. (London: Faber and Faber, Ltd., 1943.) 12*s*. 6*d*. net.

SIR GEORGE STAPLEDON is perhaps the greatest living example of a type of scientific mind which with increasing academic specialization and on account of the change in the nature of scientific inquiry towards the quantitative rather than the qualitative is less common than it was. He might be compared with the Darwins, John Bennet Lawes, and K. Timiriazev [see p. 138 of this issue] in being well known beyond the walls of universities and in having found his best inspiration outside the laboratory and with a social rather than a theoretical leaning. His bent may be called the generalizing descriptive, distinct from the taxonomic and the quantitative; it is clear from this book that he prefers the energetic to the inductive, and H. Bergson to R. A. Fisher. His greatest admiration for a man of science is bestowed on G. Turesson, the Swedish student of plant ecotypes.

Sir George is an appreciated popularizer of an idea, or rather a close-linked series of ideas, arising out of the study of the natural history of plants and intended to raise the status of his country's agriculture. These ideas are so well known that it is almost superfluous to mention them here. The book will be useful to the agriculturist who is unaware of Sir George's thesis—if there is any such person; it will be more useful still to the person who thinks he knows about the ploughing-up and rotation of grassland, and wishes to refine his knowledge.

The book consists of twenty-two essays and addresses dating from 1912 to 1942. Most of them have not been published in full before. The presidential address to the Agricultural Section of the British Association is included here, and deserves re-reading because it brings to light the curious neglect of the study of rotation. It suggests other instances of neglect of scientific consideration of problems of actual farming, such as give openings to critics of the organization of agricultural science. Together, the essays form what the publisher describes as the autobiography of a point of view. It is the point of view of an explorer eager to tell of what he has seen, and of what can be done, in a new land; but his *terra incognita* lies at home. He has discovered the grasslands of Britain, some of them high up, where few besides the shepherd and the farmer ever tread; others, low down, and traversed by the railways and hunting packs of central and southern England. He has discovered the potentialities of the often-overrated grazing land; how there is scarcely any that cannot be improved and made farmable by being ploughed up and wisely managed. For once, the better will be the friend, and not the enemy, of the good. Characteristic is the observation that much land that was permanently hayed has had its fertility transferred via the stables of the big towns to the market gardens, which are sinks of fertility.

The ideas of Stapledon actually affected only a small proportion of the vast campus over which he would like to operate: a few hundred acres at most owe their improvement directly to him. But the seed was only dormant. There cannot be much doubt that the way of the land in current agricultural policy is in part its fruit: to this Churchill among agronomists his hour came. The present value of this book is difficult to assess. To some, the book may seem redundant, but perhaps there is an implied tribute in that. The value of this work will almost certainly be great to the agricultural historian of fifty years hence, who will see clearly developments hidden from us either because they are contemporary or because they have not yet come fully to fruition.

HUGH NICOL.

Fluid Mechanics and Statistical Methods in Engineering

By Hugh L. Dryden, Theodore von Kármán, Anton A. Kalinske, Thomas K. Sherwood, Samuel S. Wilks, Walter A. Shewhart, Leslie E. Simon, Roscoe Pound. (University of Pennsylvania: Bicentennial Conference.) Pp. v+146. (Philadelphia: University of Pennsylvania Press; London: Oxford University Press, 1941.) 10*s*. 6*d*. net.

THE book is divided into two sections, each consisting of separate papers of a mainly expository character. The best idea of such heterogeneous material will be conveyed by enumeration. The first section, "Fluid Mechanics", contains four papers. "The Role of Transition from Laminar to Turbulent Flow in Fluid Mechanics", by H. L. Dryden, gives an introductory survey of the various aspects of the problem of transition, with diagrams. "Problems of Flow in Compressible Fluids", by T. von Kármán, gives a short review of a few problems connected with high-speed flow and high-speed motion of solids in fluid media with particular reference to aeronautics and exterior ballistics. "Investigations of Liquid Turbulence and Suspended Material Transportation", by A. A. Kalinske, gives an account of transportation of suspended matter in an open channel. "Mass Transfer and Friction in Turbulent Flow", by T. K. Sherwood, gives a brief discussion of various theories proposed in this connexion.

The second section, "Statistical Methods in Engineering", also contains four papers. "Contribution of Mathematical Statistics to Scientific Methodology", by S. S. Wilks, gives an account of the principles and scientific significance of the methodology for making predictions from observations, together with the appropriate measurements of confidence. "Contribution of Statistics to the Science of Engineering", by W. A. Shewhart, gives an outline of the theory of repetitive operations on order to provide the engineer with a method of regulating such operations to the best advantage. "Contribution of Statistics to the Development and Use of Purchasing Specifications and Standards of Quality", by L. E. Simon, outlines the genesis of a statistically sound acceptance specification. "The Relation of Statistical Quality Standards to Law and Legislation", by R. Pound, inquires whether statistical methods cannot be used to point the way in certain aspects of legislation.

In so far as the articles are expository they may appeal to the general scientific reader interested in such matters; indeed it is difficult to see for whom else the collection can be intended.

Apparitions

Being the Seventh Frederic W. H. Myers Memorial Lecture, 1942. By G. N. M. Tyrrell. Pp. viii+123. (London: Society for Psychical Research, 1943.) 3*s*. 6*d*.

IT might be thought that Mr. Tyrrell, in choosing the subject of apparitions for the seventh Frederic W. H. Myers Memorial Lecture, was returning to that kind of anecdotal psychical research which is gradually giving way to a more quantitative and philosophical approach. Such, however, is not the case, for in this lecture Mr. Tyrrell is approaching the subject of apparitions from the only angle from which such phenomena can be properly approached, namely, that which supposes such appearances to be in general hallucinations of a peculiarly interesting and important kind. Mr. Tyrrell supposes that apparitions are caused by the existence of what he calls "idea patterns", by which he means images which are the direct expressions of the agent's ideas and which are externalized as full-blown hallucinations. What is seen is, to use Mr. Tyrrell's phrase, merely "a psychological marionette", the outward expression of a drama which has been thrown into sensory form, and thus a close and detailed study of its production might be expected to throw considerable light on the various strata making up the human personality. It is true that the facts of collective hallucination and similar experiences, which are apparently shared by both children and animals, are not altogether easy to fit comfortably into the framework Mr. Tyrrell has constructed for them; but generally speaking it would be a mistake to lay too much emphasis on incongruities and difficulties which may eventually be found to be superficial rather than fundamental. What Mr. Tyrrell has done has been to direct attention to the need of examining apparitions from the psychological and philosophical points of view; and such an attempt can only be made by those who have rid themselves of naïve assumptions bred from prejudice and lack of acquaintance with the facts. Such an approach is to be welcomed and will, it is hoped, be extended to other branches of the studies comprised under the comprehensive title of psychical research.

An Encyclopædic Dictionary of Science and War

By Surgeon Rear-Admiral C. M. Beadnell. Pp. xviii+293. (London: Watts and Co., Ltd., 1943.) 25*s*. net.

IT is in the nature of things that one is more intensely critical of dictionaries than almost any other documentary material, so let it be said at once that the present volume is a remarkable achievement for a single author. He is well known as a lifelong student of ballistics, and, carefully avoiding the ground recently covered by other technical dictionaries and encyclopedias, has contrived to concentrate on ballistics and such sections of chemistry as explosives, war gases, and the elements, as have primary functions in war-time. Where desirable, extensive tables give the data in easily accessible form, with one dire exception: if one requires any of the mass of information which is given about an element, one is retarded by the time required to disentangle each item, since for each element the items run on. There are inevitably some obvious misprints in these masses of data. Much space is saved for useful information by a considerable series of contractions, which are listed separately.

While one might insist that the volume be titled "Science in War" instead of "Science and War", one can also blame the author in not being scientific in his diverse use of dimensions. Any magnitude is inevitably accompanied by its translation from, say, inches to centimetres, miles, etc., seconds into hours or years. The author might consider being more scientific in a new edition by adopting throughout the metric system in multiples of 1,000. The inevitable simplification of units in the future would be accelerated if authors of such standardizing books as the present show a lead and indicate the public usefulness of the metric system.

L. E. C. HUGHES.

EDUCATIONAL RECONSTRUCTION

THE long-awaited White Paper* setting forth in full the Government's policy and intentions in the matter of educational reform is now before the public, and will no doubt be discussed from every point of view. For the moment we confine ourselves to a summary of its principal proposals, reserving further comment for a later date. The cautious mode of procedure adopted by Mr. Butler commands general approval. The teachers, the administrators, the churches, the parents, and the existing local authorities may now know just where the Government stands, and are free to criticize before an Education Bill is introduced in Parliament. No one who recalls the stormy scenes of 1870 and 1902, and the fate of some of the best proposals of 1918, can wonder at Mr. Butler's studied patience and wariness. As in 1918, the fact that the coming Bill will be introduced on behalf of an all-party or non-party Government will facilitate its passage through Parliament, but it is to be hoped that it will do so with ultimately better results.

The Paper envisages national education in three stages—primary education, secondary education, and further education. The traditional term 'elementary', which has long been a rather absurd anachronism, will now disappear from the official vocabulary. No longer will it be implied that teaching the 'elements' of the three R's is almost the *raison d'être* of the people's schools, and no longer will the parent's duty be confined to causing his child to be efficiently instructed in the three R's. His duty, as laid down in this Paper, will be "to cause his child to receive efficient full-time education suitable to the child's age and aptitudes" (par. 24).

Primary education is defined as covering the period up to eleven or twelve. The age for compulsory attendance at school, namely, five, will remain as now. Primary education is to include the nursery school, for children from two to five, the infants' school, for children between five and seven or eight, and the junior school, for children between seven or eight and eleven or twelve. Here we seem to have a convenient fixing of terminology which was necessarily left rather fluid in the Hadow Report on the primary school. There is now to be a comprehensive stage of primary education, of which the last part is the junior stage. As to nursery schools, the weak word "may" is to be replaced by the mighty word "shall". Otherwise expressed, "it is proposed to substitute for the present power of local education authorities a duty to provide, or aid the supply of, such nursery schools as in the opinion of the Board may be necessary". Good reasons are given for preferring self-contained nursery schools to nursery classes attached to infants' schools. Though no special prominence is given to the subject, the proposed provision for nursery schools is, for its social consequences, probably the most far-reaching thing in the whole document. Good reasons are again given for separate infants' and junior schools, wherever the numbers justify the arrangement. The psychological differences between the two stages are in general a part of "what every woman knows" and many men also. The very large classes in many infant and junior schools are condemned unsparingly as affording "not education but mass production".

One of the most striking passages in the White Paper, also far-reaching in its educational consequences, is the condemnation (par. 17) of the present arrangements for transition from the junior schools to the post-primary schools. "There is nothing to be said in favour of a system which subjects children at the age of eleven to the strain of a competitive examination on which not only their future schooling but their future careers may depend. Apart from the effect on the children, there is the effect on the curriculum of the schools themselves. Instead of the junior schools performing their proper and highly important function of fostering the potentialities of children at an age when their minds are nimble and receptive, their curiosity strong, their imagination fertile and their spirits high, the curriculum is too often cramped and distorted by over-emphasis on examination subjects and on ways and means of defeating the examiners. The blame for this rests not with the teachers but with the system." So it is proposed to make a clean sweep of this unhealthy form of competition, a competition which is pernicious at any stage.

Coming now to secondary education, we observe that there are to be three types of secondary schools, to be known as grammar, modern and technical schools. The grammar school will be of the type represented by the present secondary schools, and the modern schools will be of the type represented by the existing central and senior schools. It is fully recognized that there are, in areas where re-organization has taken place, enormous differences between the two as to premises, equipment, staffing and what are called amenities but could often be more correctly described as decencies. Meantime the word 'secondary' is to be hopefully applied to both types, as well as to the technical schools, which have achieved so much success since they were started in 1905. The intention to raise the leaving age to fifteen without exceptions as soon as possible after the War, and to sixteen at a later date, will of course have an important effect on secondary schools of all types. A child who is found, say, at the age of thirteen, to have been wrongly placed at the age of eleven may be transferred to a school more suitable for his bent and talents.

From the fact that religious education and the position of the voluntary schools occupy far more space than any other topic, amounting to nearly a quarter of the whole Paper, it may be inferred that the old difficulties have been fairly faced. One thing is clear. There is a very general wish, not confined to representatives of the churches, that religious education should be given a more defined place in the life and work of the schools. The practice now prevailing in most primary and secondary schools of beginning the day with a corporate act of worship will now receive statutory sanction and be universal, but with due regard to the rights of conscience. In what we now know as provided schools the religious instruction will usually be in accordance with an agreed syllabus. No unwilling teacher will be compelled to give such instruction, and no teacher will be penalized for not giving it. Also, it is at last recognized that there is no valid reason why different principles should be applied to inspectors and teachers. The inspection will be limited to agreed syllabus instruction. As we have intimated, much space is devoted to the embarrassing dual system, including ts history, and the reasons why the simple solution reached in Scotland is inapplicable south of the Tweed. A plan is described by which the degree of public control will be approximately proportioned to the amount of financial support provided from public funds.

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* "Educational Reconstruction." Cmd. 6458. (London: H.M. Stationery Office, 1943.) 6*d.* net.

The principles of the Act of 1918 relating to day continuation schools are to be adopted to meet the requirements of the post-war world, but the term "day continuation school" is to be abandoned, and the institutions required for the purpose will be referred to generally as 'young people's colleges'. "It is important," says the Paper, "to make clear that what is in view is no 'going back to school', a mere extension on a part-time basis of previous full-time schooling, but the entry on a new phase of life and development." Certain basic elements will be included in the training, and when these have been met the remaining hours may be devoted to a variety of subjects according to the needs and capacities of each individual.

The field covered by the term "further education" is obviously a wide one. The provision of further education is at present a power and not a duty of local authorities, and despite what many authorities have done, technical education has not made the advance which the needs of a highly industrialized community demand. To some extent the industries themselves are alive to the need of ordered systems of training, and by consultation with the Board of Education and the Ministry of Labour it is hoped to build up in each major industry a system which will be accepted and applied not by individual firms here and there, but on a national basis throughout the industry.

The White Paper emphasizes that without provision for adult education the national system must be incomplete. After all has been said about other forms of education, it is "within the wider sphere of adult education that an ultimate training in democratic citizenship must be sought". While the more serious and solid studies that have formed the backbone of adult education at its best must be maintained, there will be room for new methods and new approaches to meet new demands. Upon this question the education services that have operated in the Forces have thrown much light.

Mention is made in the Paper of the Youth Service brought into being to extend the recreational training of young people by assisting the voluntary organizations. In spite of the restrictions imposed by war conditions on the supply of leaders, premises and equipment, the service has shown a remarkable expansion. "There is now a far higher proportion than at any previous time of young people associated with healthy leisure-time training and recreation without compulsion or regimentation of any sort." The section on health service, we may add, extends existing facilities for securing the physical well-being of children and young persons.

On the subject of access to the universities, it is noted that the path of the poor scholar has been made broader and less difficult during the last twenty years, and that the expenditure by the Board through the system of State scholarships and by the local education authorities through their major awards has been a profitable investment, judged by the successes achieved by the beneficiaries. None the less, the system is inadequate. Again the difference between giving a power and laying a duty upon a local authority obtrudes itself, leading to a wide disparity in the opportunities of poor students. Upon this question the Norwood Committee's advice is now available for the guidance of the Government. The Paper hints that this is not the only direction from which provision may be made for highly promising persons after the War.

At various points in the course of the Paper the reader is reminded that legislation can do little more than prepare the way for reform. "It will rest with the Board and the local authorities, and, not least, with the teachers working in the schools, to translate its aims into practice." All along the line, through primary and secondary and further education, it is obvious that more, a great many more, teachers will be needed. But, says the Paper, it is not merely a larger number of teachers that will be required, but a larger number of the right kind. "It would be deplorable if the necessary corps of teachers could be obtained only at the expense of lowering existing standards. It depends almost entirely upon the quality of those who staff the schools whether the reforms proposed will be merely administrative reforms or whether they will, in practice, work out as real educational reforms." These questions of the supply and training of teachers are being investigated by the McNair Committee, and the recommendations of that Committee are awaited. Meantime the Paper points out frankly what is "patently wrong" with the present system of recruiting and training teachers, and some of the reasons why an expert inquiry was long overdue. The field of recruitment is narrowly limited to those boys and girls who remain at grammar schools until 17 or 18, and the educational history of teachers is nearly all of one uniform pattern. As to the period immediately following the War, "there are many men and women now serving in the Forces or elsewhere whose experience and devotion would greatly enrich the education of children".

The Paper concludes with some plain speaking on the subject of "independent schools", that is, schools which stand apart from the State system. The expression includes all manner of establishments, from those which are excellent to those which, according to the report of a Departmental Committee in 1931–2, are so defective as to be harmful to the physical and mental welfare of the children, and those —a larger number—which are seriously deficient and inefficient. At present anybody, whatever his or her qualifications, can start an independent school in any building and, unless the use of the building constitutes a nuisance under the public health acts, its improvement or closure cannot be obtained. The Paper proposes that all independent schools must be open to inspection by the Board and registered on a list kept by them, and that schools found to be defective shall be suitably dealt with. It is characteristic of our national feeling in such matters that, in order to ensure that reasonable liberty shall remain for those schools outside the public system, the proprietor of a condemned school will have the right to appeal to an independent tribunal against the Board's decision.

Such are the main contents of a document, remarkable alike for its comprehensiveness and its lucidity, which will provide thoughtful citizens, both young and old, with food for thought during the next few months. No doubt much of further interest and value will accrue from the Parliamentary debates which will follow.

ADOLESCENCE AND SOME PROBLEMS OF YOUTH TRAINING*

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IN a short article one can of course attempt no comprehensive survey of the psychology of adolescence. I propose merely (i) to supply further evidence on some points in view of the revived interest in the training and guidance of youth, (ii) to question one or two assumptions usually made, and (iii) to indicate certain basic problems.

As my first section below gives results gathered by means of questionnaires, a word may be said on the scientific value of such inquiries. Provided that these reports are anonymous, as in my own inquiry, I am sure that one can gain valuable information from them. In using questionnaires, however, one must beware of distributing them widely and then only dealing with the selected records of those who have taken the trouble to reply. Such are liable to be those who have something particularly interesting to report of their adolescence, or those who enjoy the opportunity of writing about themselves. The danger is avoided when one presents the questionnaire to a group of people and gets replies from every one, though of course we have to bear in mind the selected nature of the class itself, in this case university graduates. My own questionnaires were filled in by 220 graduate students during the years 1926, 1927, 1930 and 1942. Similar inquiries among students and wage-earners were made by Prof. Olive Wheeler[1]. In addition, I had some hundred or so confidential essays from students based largely on their own adolescent experiences, which were astonishingly frank. (I guaranteed that no one should read them except myself.)

The students (120 women and 100 men) were asked whether they had experienced during adolescence a marked intensification of various kinds of emotional experience or a decided change in certain attitudes, and to give the ages at which these changes began and ended. I give some of the most interesting results.[2] Marked increases or intensifications were reported as follows: as to religious experiences, women 74, men 78 per cent; interest in a member of the same sex (something approaching 'love'), women 72, men 50 per cent; aversion from opposite sex (at an earlier period usually) women 45, men 45 per cent; moods of intense dejection, women 76, men 61 per cent; contemplation of suicide, women 29, men 38 per cent.

There is general agreement that some of the main characteristics of adolescence, especially the instability of emotions and impulses, are closely connected with, if not entirely dependent upon, the maturing of sex. A point here which is apt to be overlooked is the wide range of ages at which sex maturity arrives. For example, among girls in the United States, one quarter begin menstruation before the age of 12½, one quarter do not begin until after 14½[3]. While there does not seem to be a complete correlation between puberty and the mental stages, the very close connexion is enough to caution us against treating a given set of children of twelve or fourteen or sixteen years of age as essentially at the same stage of development.

Further evidence in support of this is found in the great variations in the age at which various characteristics appear. Thus in women moods of intense dejection began so early as twelve, in others not unti nineteen or twenty years of age; a keen interest in the opposite sex began in some so early as eight, in others not until twenty; strong aversion from the opposite sex varies from eight to sixteen or never Among the men an expectation of future greatness appeared at varying ages from eight to eighteen, or never.

The confidential essays revealed that many adolescents imagine their strange moods and impulses to be unique, which creates a feeling of intense loneliness.

The main sources of mental trouble seemed to the youths to be intense self-consciousness (accentuated if there was excessive size or extreme awkwardness), distress at social evils which seemed insoluble (unless the individual could have a free hand to deal with them), unhappy relations with parents, struggles with doubt about religion, sometimes disgust or fear at the first experience of sex emotions, or, in the case of girls, of premature advances by boys or men. There were also comments which confirm the view that the adolescent's wish to be independent of his parents' support and to feel himself a 'man' and enjoy greater freedom is a main cause for wishing to become a wage-earner at fourteen or as soon as possible.

One thing is clearly demonstrated by some of the essays, namely, that some of the intense feelings of inferiority during adolescence were consistent with remarkable strength or ability clearly demonstrated a few years later, even in those very things in which weakness had been felt. Thus several students who experienced intense feelings of inferiority and lack of confidence did brilliantly at the university and took a prominent part in the university life.

Another fact which emerges clearly is that some of the girls who had most intense feelings of affection for older girls or mistresses—real 'crushes'—turned out to be among the finest in character and ability at university stage. Some of these girls had been caused great unrest—acting like fond doting lovers—kissing the book lent to them by a beloved mistress, walking up and down the road past the house where the loved one lived, and so on.

In another inquiry I made in which students who had been at co-educational schools were compared with those at boys' or girls' schools, such homosexual attractions were far less frequent in the co-educational schools, and students from these schools were almost unanimously in favour of them.

Should we Discuss Adolescence with Adolescents?

A practical problem arises as to how far we could help the adolescent by letting him know that the great variations of mood, of extreme elation and dejection, or the contemplating of suicide, are often passing phases of the adolescent life. Such talks have indeed been suggested by some important bodies dealing with the training of young people. It would seem helpful to inform an adolescent that he is likely to be subject to extreme moods and, in particular, that he is not alone in the unhappy inclinations to run away from home or even to commit suicide. My own reports show clearly that many adolescents feel a greater distress because they think their own inner struggles are unique. On the other hand, to speak to adolescents of the common intensification of religious interest, or of high ideals, as passing characteristics of this adolescent phase, or of the expectation of accomplishing great things in life as a common illusion, would seem clearly undesirable.

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* Based on a paper read before the annual general meeting of the British Psychological Society at Oxford during April 8-12.

One matter at least could be spoken about, namely, the plain facts of sex development. It is clear that even in these days, in some cases, young people are allowed to experience the first signs of physical maturity without having been warned beforehand. In my own work of giving psychological analysis and treatment, I have known several cases in which great early distress due to ignorance about sex development set up neurotic conditions lasting for a considerable time, indeed until relief followed the discovery of their origin.

Delinquency during Adolescence

It is too commonly assumed that the main cause of juvenile delinquency is the removal of the child from school at too tender an age into the socially dangerous life of the young worker. But if we take into consideration the relative population for each age, it appears that thirteen is the age at which the percentage of juvenile delinquents is greatest[4]. When boys leave school and become wage-earners, delinquency actually decreases.

Reference to the figures will also show the surprisingly high numbers for delinquency among boys at the ages of twelve, eleven and even ten, in spite of the reluctance to bring delinquencies of younger children to official notice. Hence we cannot assume that the major cause of juvenile delinquency, among boys at least, is the removal from school and the mixing with older men, or the greater freedom due to employment, though for many, no doubt, it is a precipitating factor.

Among girls the frequency of (reported) delinquencies is, of course, very much lower than among boys (about one tenth) and the peak age is appreciably later in adolescence; this is no doubt due largely to the fact that such a considerable number of girl delinquencies are connected with sex.

In several inquiries it has been shown that juvenile delinquents are less often members of youth clubs than are their opposites in the control groups. Mr. W. L. Chinn found, among 1,000 juvenile delinquents in Birmingham, that only 31 per cent belonged to "recognized social organizations", while among the controls 61 per cent belonged to them[5]. (Chinn included children from the age of ten up to fifteen. The figures for children between fourteen and fifteen were: delinquents, 17 per cent; non-delinquents, 53 per cent.)

One important question, however, has to be borne in mind in considering such results. We do not know how far such differences are due to the fact that it is the 'good', socially well-adjusted boys who choose to become members of clubs, while those more inclined to delinquency are indifferent to such clubs; or, how far the difference is due to the good influence of the clubs upon the boys who do join them. The importance of selection seems undoubted. An examination of the results found by Carr-Saunders and his colleagues in the recent inquiry[6] confirms this view. They first of all eliminated from their consideration the 'abnormal' homes ('broken' homes or homes where there was bad discipline, or undue friction between the parents, or where one of the parents was unemployed or in bad health, or failed to reveal regular and exemplary habits). Taking only the 'normal' homes, they found the following figures:

REGULAR CLUB MEMBERSHIP

	London	
Delinquents	(273 in number)	29 per cent
Controls	(550 in number)	35 per cent
	Provincial cities	
Delinquents	(264 in number)	28 per cent
Controls	(539 in number)	30 per cent

In other words, where the homes were fairly satisfactory, regular club membership made very little difference as to delinquency.

This leads us, however, to ask another question. What would the figures be if these investigators had found the figures for *abnormal* homes? It is precisely among children from homes with bad influence that we should expect clubs to be most valuable. It would also be of great interest to find how the proportion of adolescents joining some club was affected by their coming from 'normal' or 'abnormal' homes. The same principle of selection applies to the figures for attendance at a church, when there was only a difference of 10 per cent between delinquents and controls. The figures for *attendance at evening schools* show still greater difference—only 7 per cent for the delinquents, nearly 33 per cent for the controls. Again we cannot of course assume that the evening schools had much direct influence on the tendency to delinquency or that compulsory attendance at evening schools would reduce delinquency. The main reason for the difference is again probably that the more serious, ambitious, or obedient pupils would attend evening schools, though no doubt occupation on some evenings would lessen the temptation to commit petty offences.

As to *home discipline*, there was a decided difference between the delinquents and the controls. In less than 60 per cent of the delinquents' homes was the disciplinary attitude satisfactory, whereas the figure for the controls was nearly 90 per cent. We may recall that Burt found that bad discipline in the home gave the highest correlation with delinquency, of all the factors he examined[7]. This confirms the view that the problem of delinquency and the training of youth cannot be solved by treating the youth himself in schools or clubs. It must also be tackled in the home itself, and some attempt made to educate parents in at least elementary principles of discipline. In interviewing (with school attendance officers) the parents of children who had been persistent absentees from school, I have been appalled at the stupidity of the attempts at discipline—or lack of them—to which parents confessed. I have no exact figures, but my general impression is that considerably more than half the difficulties were chiefly due to this: and if we include frequent illnesses in which there was also subsequent over-indulgence and lax discipline, nearly all cases would be covered.

One fact that is often overlooked is that many youths seem to survive the worst possible environment, while others succumb even in the most favourable environments; for example, more than 40 per cent of the delinquents come from normal homes where the atmosphere and discipline seemed satisfactory; while nearly 30 per cent of the non-delinquents come from homes without such normal atmosphere. These facts lead the authors of "Young Offenders" to a conclusion similar to that I drew from investigations as to younger children[8], namely, that (i) there are some children who will develop sound characters in almost any type of environment; (ii) there are some who will go astray even in the best types so far as we can discover it; and (iii) there is a large intermediate section whose development will be profoundly affected by their environment.

The Youth Movement and Club Membership

The recent registration of youths, and the recommendations given to them to join some youth organization, should provide valuable material for the study of youth training, particularly if careful follow-up studies are made as to what happens to those who are not already members of some 'approved' organization. In Birmingham a report made to the Education Committee in September 1942 revealed that some 47 per cent of the boys aged sixteen and seventeen were not undertaking any 'approved activity' (which included junior service organizations) and were not receiving any systematic education. As to girls, it was found that as many as 73 per cent were not engaged in any approved activity. It should be noticed that the proportion of girls without 'approved activities' was actually greater at seventeen years than at sixteen, the figures for girls of the latter being 69 per cent and those of the former 77 per cent.

All young persons who were not attached to some organization were urged to join one and given an introduction to one of their own choosing. Only 18 per cent of the boys and 29 per cent of the girls were unwilling or unable to achieve introductions to such organizations. The larger organizations were afterwards asked to give their reports of the result of these introductions.

Reports as to boys were received from the Cadets, A.T.C., Navy League, Boys' Brigades, Boy Scouts, and Boys' and Girls' Union. None of these obtained more than a few new members, and many of these disappeared in a few weeks. The same was found for girls in the G.T.C., J.A.C. and Boys' and Girls' Union, but the Y.W.C.A. retained a considerable number.

Reports suggested that the long hours many juveniles were working, the need for help from the girls in the homes, especially where the mothers were working in factories, and the objection of parents to young people being out after 'blackout', all militate against the joining of organizations[9].

Even if the statistical evidence is not conclusive as to the value of club membership, few would doubt, on the mere basis of the general psychology of adolescence, that it is desirable to expand the provision for healthful and cultural leisure pursuits and also of opportunities for useful service.

The question of compulsory membership of youth organizations is a difficult one. It is agreed, of course, that education must be compulsory even if the youth himself would at the time prefer to do without it. If we accept this principle, then, so far as the Youth Movement includes 'educational' items, compulsion might seem to be justified by the same principle, at least up to corresponding ages, for those not continuing in full-time or part-time education. Another complication is the enormous variety of clubs and organizations, some of which can provide educational facilities, while others can only cater for recreation.

The whole matter is complicated by the question of continuation school education. If this were s organized as to provide essential education, yout organizations need only cater for additional interest and supplementary courses and recreations.

As to recreative pursuits, many hold that the whol atmosphere of the Youth Clubs would be spoilt i any element of compulsion were introduced, an indeed even compulsory educational courses migh tend to create the unpopular atmosphere of a 'school'. No doubt the ideal is that the leisure activities should be so attractive as to need no further stimulus. Th highly successful Sherbourne Youth Club in Birmingham, though catering for the roughest types of youths, has been able to impose compulsory attendance at some educational activity through the attractive power of its recreations, and still expand beyond capacity.

On the other hand, young people need at least some *information* as to what facilities are open to them. The Birmingham inquiry showed that often a youth ceased to attend some club after only one or two visits. But how many adults enjoy a first night alone in a holiday hotel, or what man is at ease the first day or two in a new club?

I suggest that some compulsion—or at least some compulsory choice of several alternatives—may be desirable, but only *for a time*, in order to give the youth the opportunity at least of judging whether this particular activity appeals to him, it being made clear to him that this is the only reason for compulsory attendance.

A further question arises as to whether there should be some compulsory form of service for the community. It is not the concern of a psychologist to discuss the rights and wrongs of State control, State propaganda, or the question as to how far the State should demand service of its young people. I merely wish to suggest here that we cannot assume, as is often done in educational discussions, that, because some service is made compulsory during adolescence, the youth will therefore become accustomed to this, and so become less selfish and give service voluntarily later on. This, I suggest, would only happen if in doing such compulsory service the youth discovered a new satisfaction and interest which he realized he would have missed otherwise. It is possible, indeed, that the compulsion to carry out 'good deeds' may have the opposite to the desired effects.

We should therefore look askance at such vague phrases as 'training youths to be co-operative' or 'unselfish', which are so often used in discussions on education, and we should demand much more specific statements as to *how* such 'training' is to be made permanently effective.

Finally, so far as service is appealed for, among our young people, it should surely be based on the ground that their help is needed and useful, and not that it is good for them. Indeed, it is only service given on such a basis that is in fact likely to be 'good for their soul', for it is that which will appeal to them most.

[1] See Prof. Wheeler's book "Youth" and her article in the *British Journal of Educational Psychology*, 1 (1931).

[2] A detailed account of the results and fuller quotations from the confidential essays are given in my article in the *British Journal of Educational Psychology*, 13 (June, 1943).

[3] Hollingworth, Leta S., "The Psychology of the Adolescent", p. 20.

[4] See figures quoted in "Young Offenders", p. 164 and also pp. 120–21.

[5] *Brit. J. Educ. Psych.*, 8 (1938).

[6] *Brit. J. Educ. Psych.*, 8, 88–89 (1938).

[7] See "The Young Delinquent".

[8] "The Difficult Child and the Problem of Discipline", p. 24 (Methuen).

[9] Fuller details of these reports and further discussion of results are included in my article in the *British Journal of Educational Psychology*, 13 (June, 1943).

TEN YEARS OF GROWING EXCISED TOMATO ROOTS

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MARCH 1, 1943, marked the decennial anniversary of the starting of the first uninterrupted cultures of excised plant organs[28]. The root tip from which was derived the standard clone now used in all experimental studies on excised roots carried out in this laboratory was severed from its seedling parent on March 1, 1933. This root is still growing. From it have been made some 80,000 experimental cultures. In addition to these cultures for which increment data are available, large stocks have been maintained on which detailed records were not kept. The total measured increments represent many kilometres of growth; the theoretical increments[28] amount to staggering figures (*ca.* 10^{2800} kilometres). It seems appropriate at this time to review briefly the history and behaviour of this clone.

Aseptic seeds of Bonny Best tomato were sown on sterile filter paper late in February 1933. When, on March 1, the seedling roots had attained a length of a centimetre or more, twenty-five of them were excised and each one placed in a separate flask. The nutrient[24] was, as was soon discovered, not a very satisfactory one. Only one of the 25 roots grew. This was transferred on March 13 to fresh nutrient of a somewhat different and more satisfactory formula[28]. From this root, during an initial period of ten passages averaging 13 days per passage (127 days), a clone of 100 cultures was built up. This number was maintained through 42 subsequent passages of 7 days duration each (294 days), during which time each culture was measured daily. At the end of the fifty-second passage (421 days) the number of cultures in the measured stock was reduced to 25 and measurements were recorded thereafter only at the beginning and end of each weekly passage. Measurements of initial length, final length, number of branches, and length of longest branch together with notes on general behaviour were recorded for each culture.

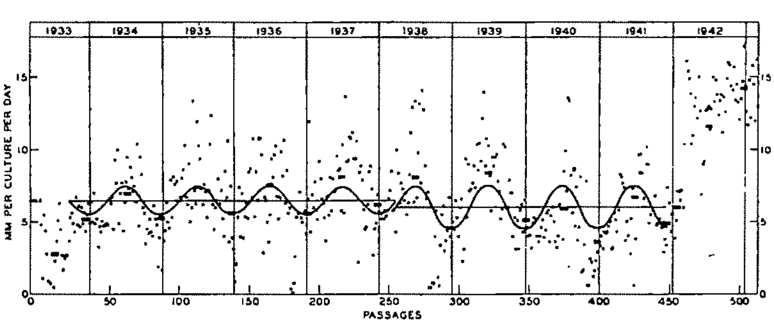

Chart showing the week-by-week increment rates of a single clone of growing excised tomato root tips over a period of ten years (523 passages). Each dot represents the average increment of 25 cultures during a single week (see text for exceptions in the first 52 passages). The average for each 26-week inter-equinoctial period is shown by a thick horizontal dash. The sine curves are drawn with nodes at the equinoctial points, the maxima and minima being drawn to correspond with the mean summer-winter fluctuations for the particular long-term periods represented by each distinct base line.

Transplants were made wherever possible by severing a piece about 15 mm. long from the apex of the culture[94]. Where, as occasionally happened, a culture became contaminated or the apex ceased to grow normally, this procedure, of course, became impossible. Such cultures were replaced where feasible by using the tip of a branch root which had already acquired its own dominance equal to that of the apex and was thus capable of equally rapid initial growth. This state is usually attained in tomato roots when the branch has reached a length of about 20 mm.[94]. When such branches were not available, fragments of the main root carrying one or more growing points which had not yet acquired this individual dominance were used as explants. Records were kept in such a way as to distinguish between these three categories: primary apices, secondary but dominant apices, and secondaries lacking established dominance, since cultures of the third category, in particular, usually showed a considerable lag in increment until some one branch acquired its own dominance.

A number of points of interest appear in the growth record for the ten years (512 passages). It has already been noted[48] that the average growth-rates, in spite of their wide and apparently random week-to-week variation, nevertheless approximate a sine curve when grouped in 26-week blocks beginning at the vernal and autumnal equinoxes. The average increment-rate for the entire ten years was 6·73 ± 0·15 mm./cult./day. If we ignore the initial 20 passages which preceded the establishment of a standard procedure (average increment 3·05 ± 0·42 mm.) and begin with the autumnal equinox of 1933 (passage 21), there was no significant change in *average* increment-rate until the vernal equinox of 1938 (passage 254), that is, during the first 4½ years. Throughout this time the nutrient consisted of a modified Uspenski salt solution, sucrose, and yeast extract, and the original standard procedure was maintained. The average growth-rate for this period was 6·47 ± 0·15 mm./cult./day. The average summer rate was 7·47 ± 0·27 mm., while the winter average was 5·60 ± 0·15 mm./cult./day. The difference between these, 2·22 ± 0·24, is 33 per cent of the average value—hence highly significant.

The interval between the vernal equinox of 1938 and a time shortly after the autumnal equinox of 1941 (passage 447) represents a second important culture period (3½ years). During this period a number of changes in procedure were tested. Chief among these was the substitution of glycine[77], thiamin[40,43,52], and certain accessory salts[64] for the yeast extract employed throughout the earlier period. These irregularities and changes in procedure resulted in a slight decrease in mean increment-rate and a concomitant increase in range of variability to 6·06 ± 0·22 mm./cult./day. The decrease is statistically of doubtful significance, the difference being − 0·47 ± 0·24 mm. With passage 448 a new and improved inorganic nutrient was introduced[92]. This resulted in an apparent improvement in growth (4·9 ± 0·3 to 6·1 ± 0·9 mm. in the consecutive 13-week periods representing equivalent segments of a single inter-equinoctial period), but the period tested was too short for the difference to be statistically significant (difference = + 1·29 ± 0·9 mm.). With the vernal equinox of 1942 a more important change was made. At this point pyridoxine and niacin were introduced[91] into the nutrient according to the recommendations of Robbins and Schmidt[74–76] and Bonner[78]. This resulted in a sharp increase for the following year to a level of 12·6 ± 0·8 mm. The increase here, over the previous mean rate, was + 6·1 ± 0·8, hence highly significant. This last nutrient has been used for too short a time (54 passages) to establish a new seasonal cycle. The results so far suggest, however, that the seasonal cycle may become much less pronounced in this nutrient. The impression given is that the great number of nutrient materials available and the more nearly optimal complex of environmental conditions provide a buffer against the injurious effects of certain variables, especially temperature fluctuations[49]. This is presumably comparable to the means by which field conditions permit plants to survive and prosper under a range of variables to which they would succumb in the laboratory.

The random week-to-week fluctuations observed throughout the ten years are, for the most part, not capable of interpretation. The causes of a few are, however, known. The sudden drop in the 179th to 181st passages is such a one. This almost resulted in loss of the entire clone, for in the 181st passage, out of the 25 cultures only a single one, No. 12, survived. The entire clone was recovered and re-established from this single root tip, and even in this case the primary tip and all six of the secondary tips were killed, the meristem being recovered from nine newly established tertiaries. The cause of this near-tragedy was traced to a split in the condenser tube of the still used in preparing distilled water, allowing tap water to pass into the supposedly pure water supply. This was not city water but came from deep wells. The toxic agent is not definitely known but was probably a trace of lubricating oil shown to be present in the laboratory water supply in considerable quantity. When this condition was corrected the cultures recovered rapidly, and by the 184th passage had been built up to full number (25) and a normal increment rate (5·3 mm. as against the idealized average for that time of year of *ca.* 6·6 mm.). The sudden drop in the 228th passage was correlated with and probably the result of a very sharp drop in room temperature[49], such as sometimes occurs in mid-September. The windows of the laboratory had been left open following a very hot day, and a sudden fall in outdoor temperature was paralleled by that indoors, resulting in thorough chilling and excessive condensation on the walls of the flasks. Recovery from this was as abrupt as its incidence. The low general level between passages 279 and 287 coincided with a period of illness during which the clone was maintained by a relatively inexperienced assistant. The low level between passages 372 and 409 occurred in a period when the concentration of iron had been reduced as a result of experiments later shown to have been misinterpreted[82]. The sudden fall in passage 425 resulted from the accidental omission of iron from one batch of nutrient. Other fluctuations are, however, unexplained.

The clone is still in excellent condition and shows every evidence of potential immortality. Cultures of this stock have been sent to the University of Missouri, the California Institute of Technology, New York University and Connecticut College, where they have been maintained through various periods, for special studies and for comparison with other clones of tomato roots.

Since this note is chiefly historical in import, I have appended a chronological bibliography of all papers dealing with the cultivation of excised root tips that have come to my attention, which gives, better than could any but a very extended discussion, a panoramic view of the development of this branch of plant tissue culture. I have purposely omitted references dealing exclusively with the cultivation of other tissues or organs, except for a few of the very early background papers, since these represent a separate though closely related field.

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THE ROTHAMSTED CENTENARY

IN spite of the difficulties arising out of the War, a impressive gathering assembled at Rothamsted o July 21 to take part in the commemoration of it hundred years of uninterrupted work in agricultura science. There have been several similar occasions i the history of the Station, when the leading figure in the agricultural world have been glad to testify t the value of its activities. The first was in 1855 when a new laboratory building was formally hande over to Lawes and Gilbert as a testimonial from British farmers in recognition of twelve years pioneering work. The second was the jubilee of the Rothamsted Experiments, celebrated in 1893, when th experiments, having completed fifty years, had lef their mark not only on home farming but also on settle agriculture over a much wider area. Now, after th passage of a further fifty years, we were witnessing another ceremony—not, of course, on the international scale which would have been appropriat in normal times, but none the less a very outstanding demonstration of the high regard in which the pas and present work of the Station is held in scientifi and agricultural circles. Lord Radnor, chairman o the Lawes Agricultural Trust, presided, and th Right Hon. R. S. Hudson, Minister of Agriculture received a special welcome from the three hundre guests representing various scientific societies and al sides of the agricultural and allied industries. Representatives, diplomatic, scientific and agricultural from twenty-eight countries were present.

Welcoming the guests, Lord Radnor recalled som of the main facts in the history and achievement o the Station, and said that the completion of the firs century of work coincided with the coming retirement of Sir John Russell and the appointment o Dr. W. G. Ogg, of the Macaulay Institute of Soi Research, Aberdeen, as director. In his speech, th Minister of Agriculture pointed out how the prope use of fertilizers so firmly based on Rothamsted worl from its earliest days is now more than ever essentia in the food production campaign. He gave as a example the key position of superphosphate—th first great practical outcome of Lawes' experiments—

in the present need to establish new grass on worn-out plough land, and bring poor pasture into productive arable cropping. Fortunately, owing to the Allied victories in North Africa, the supply of this essential requirement is improving, for cargoes of phosphate rock are now coming in. He was pleased to find that, thanks to the practical example presented by land managed by war agricultural committees, farmers are more ready to adopt new methods than they have ever been. In conclusion, the Minister congratulated Sir John Russell on his well-earned retirement and expressed his hope that Rothamsted would long continue its work in fundamental agricultural research.

Sir John Russell then gave his director's address. Remarking that it was the last time that he would address an annual gathering in his present capacity, much of his speech dealt with the way in which Rothamsted fits into the general pattern of agricultural research and education in Great Britain. The function of Rothamsted, he said, is the development of a sound, trustworthy science of plant growth for the use of experts, teachers and farmers. Once the scientific principles are definitely established, the local organization can proceed to apply them to the solution of immediate practical problems—a vitally important task in modern agriculture, the success of which is limited by the amount and value of the scientific knowledge available.

The remainder of the programme was designed to give a view of the extensive and excellent modern equipment of the laboratories and farm against the background of the early history and continuity of the famous experiments. The visitors were conducted through the laboratories, where each department had arranged exhibits to illustrate important results, and special apparatus such as the electron microscope and polarograph. To amplify the necessarily short demonstrations, a comprehensive summary of the work of every department was distributed in booklet form. A recent account of the botanical investigations appeared in NATURE of July 24, p. 91. In the main hall was a collection of prints and original letters which recalled the earliest days of the Station, when the experiments were conducted in the old barn laboratory and the Lawes-Leibig controversy was in its bitterest phase.

The tour round the farm was made over a course that could be followed by tractor-drawn trailers on which the visitors were accommodated. Owing to the large company, loud speakers were called into service for the first time. Broadbalk, carrying its hundredth successive wheat crop, was the central attraction of the tour, and this year the field had risen to the occasion and produced a crop well above average. Thanks to the trailers, many visitors obtained a better view of the modern field work of the Station than ever before, for they saw many factorial plot arrangements testing problems of immediate practical importance: the substitution of potash by salt for sugar beet and barley, the utilization of sewage sludges and compost, manurial trials on flax, to mention only a few. Long-term work involving the study of slow changes in the soil was represented by rotation experiments on the utilization of straw. One of the most interesting exhibits in the farm buildings was the special equipment used at Rothamsted for laying out, harvesting, and threshing the field experiments.

The impression given by this visit to Rothamsted on its hundredth birthday was not one of age, but rather of abounding vitality. H. V. GARNER.

NEWS and VIEWS

Scientific Research in Great Britain

IN a debate on scientific research in the House of Lords on July 15, Viscount Samuel urged the need for further expansion of scientific research, particularly in relation to the utilization of coal. After stressing the need for research in all branches of science relating to food and agriculture, in nutrition, in building, in town and country planning and in the social sciences, he referred to the emphasis laid on research in the report of the Coal Industry Commission in 1925-26, and asked for an indication as to the Government's future plans for the expansion of research into all branches of the fuel and power industries. Lord Samuel mentioned the importance of giving the scientific worker himself proper status and the opportunity of advancement to administrative appointments when he possesses administrative ability, and asked whether there is any plan for allocating the work of scientific research between the three main agencies now engaged in it, namely, the State, the universities and the industries. Secondly, he asked whether anything could be said at this stage with regard to the conditions of employment of those engaged in scientific research, and whether there is any possibility of a combined scheme for pensions which would enable accrued pension rights to be transferred if a worker passes from one institution to another. Next, he inquired whether there is any prospect of a State scientific service being established parallel to the Civil Service and under the general direction of a commission like the Civil Service Commission but containing professional men of science. Finally, he again raised the question of the advisability, after the War, of appointing scientific attachés to the principal British Embassies abroad.

In supporting Lord Samuel's motion, the Earl of Listowel suggested that the Government programme to guarantee our industrial future should promote a gradual but steady increase in existing facilities for scientific research into the post-war problems of industry, an expansion including the research workers and the scientific equipment of universities, private firms and Government institutions. Secondly, to prevent overlapping and to secure the right priorities, these extended facilities should be co-ordinated and developed according to a national plan for scientific research. Lastly, it should arrange for consultation and co-operation with the Dominions and Colonies and with others of the United Nations. Lord McGowan welcomed the Government grant of £5,000,000 for research on coal, but considers that that sum will be found quite inadequate. Speaking of science in relation to industry generally, he urged that if we wish to hold and increase our export trade, there must be intensive research to find new processes and new products. Research on existing processes is day-to-day work, never ending, and accumulated knowledge creates of its own accord considerable industrial advances. Fundamental research is more a function of the universities. There is still much to be done in extending scientific academic facilities, and while this is a great opportunity for Government assistance, industry has also a big part to play, and he pleaded that industry should assist by financial grants. Lord Brabazon warmly applauded the work of scientific men in Great Britain. He also referred to the need for scientific men who could bring together and correlate the knowledge of different branches of science.

The debate was resumed on July 20, and Lord Cherwell, replying for the Government, reviewed the question of Government intervention in research. Admitting that in the last decade emphasis had tended rather away from fundamental research to the industrial side, he said that the whole distribution of effort is now being reviewed, and he hoped that it would be agreed to extend considerably Government support of pure scientific research. It is extremely difficult to make people realize the importance of fundamental scientific research and its value to the community, but even from the economic point of view we cannot overrate the importance of fostering such research. While that must be in large measure the responsibility of the Government and carried out at the universities, the Government also wishes to encourage industry to spend money on pure research. It is the policy and intention of the Government to increase the assistance given to pure research, but any similar developments in industry would be welcomed. Lord Cherwell welcomed a reference made to training in science, and said that the Board of Education is conscious much remains to be done in this field and is anxious to develop it as part of its policy for post-war reconstruction. Frankly admitting that the Civil Service has not hitherto shown due regard for the contribution which men of science are making to the nation's welfare, he stated that an investigation has been in progress to make sure that the conditions of service, pay and prospects of Government scientific employees compare favourably with those on the administrative side so that, among other things, interchange might be made easier, and he hoped that a definite announcement that these reforms are to be put into effect would be made before long. In welcoming this statement, Lord Winster expressed the view that when the history of Mr. Churchill's administration came to be written, it would contain a chapter on what has been done for the encouragement of science in Government Departments that would reflect the greatest credit on the Prime Minister.

A Pioneer of the Rubber Industry

On July 25 occurred the centenary of the death of the Scottish chemist Charles Macintosh, whose name is now a household word through his discovery of how to render cloth waterproof by cementing two layers of fabric together with a solution of rubber in naphtha. His patent for the process was taken out in June 1823, and at the works he established at Manchester the first "Waterproof Double Textures" were manufactured. His work was contemporary with that of Thomas Hancock (1786–1865), who for many years was his collaborator and partner. Together they firmly established the rubber industry in Great Britain. To Hancock also belongs the credit for the introduction of the 'vulcanization' of rubber, but he was led to the discovery of this process through experiments made after receiving a piece of rubber which had been subject to the process of 'solarization' by Charles Goodyear (1800–60) in America.

Macintosh was the son of a practical chemist and was born in Glasgow on December 29, 1766. As a youth he attended the lectures of Black at Edinburgh, and at the age of twenty began manufacturing sal ammoniac. He started the first alum works in Scotland, and for a time was associated with Charles Tennant of the St. Rollox works in Glasgow. He travelled a good deal on the Continent and was known to most of the principal chemists of his day. Among his friends was James Beaumont Neilson, F.R.S., the first engineer of the Glasgow gas works and the inventor of the 'hot blast'. In 1819 Macintosh engaged to take all the tar and ammoniacal liquor—then waste products—from the gas works, and it was in his treatment of the tar that he obtained naphtha, which he found could be used to make waterproof varnishes.

Royal Society of Edinburgh: Robert Cormack Bequest

The Royal Society of Edinburgh has been made the residuary legatee of the estate of Mr. Robert Cormack, of Edinburgh, who died on August 13, 1942. The Society is directed to administer this bequest for the purpose of promoting astronomical knowledge and research in Scotland, so far as practicable, on the lines of a memorandum prepared in 1931 by the late Prof. R. A. Sampson, Astronomer Royal for Scotland. The Council, on behalf of the Royal Society of Edinburgh, has accepted the bequest, which represents an amount somewhat over £30,000; and, after careful consideration, has approved a general scheme for the administration of the Trust, which will include: (*a*) research fellowships to be awarded on suitable conditions to students engaged on research in Scottish observatories and to students or graduates of Scottish universities desirous of engaging in research in foreign or Dominion observatories; (*b*) the publication of the results of such research; (*c*) lectures to be delivered in suitable centres by eminent foreign or Dominion astronomers; (*d*) grants in aid of the purchase of special equipment for use in Scottish universities or observatories in research work; (*e*) lectures and demonstrations of a more popular character under the auspices of the Scottish educational institutions. A large part of this scheme will not be developed during the War.

Fleas of North America

Under the foregoing title, H. E. Ewing and Irvine Fox have written a taxonomic revision of the North American Siphonaptera. Such diseases as bubonic plague and a mild form of typhus are carried to man by the agency of these insects, which also play an important part as pests of livestock, etc. The matter of correctly identifying fleas assumes, therefore, considerable importance, and the present work will aid those engaged in such procedure. Full descriptions are given of the genera and higher groups, and are accompanied, for the most part, by illustrations of diagnostic characters. Formal descriptions of species and subspecies are avoided and, instead, remarks on characteristic features are given. The paper is issued as Miscellaneous Publication No. 500 of the U.S. Department of Agriculture

(1943), and in it are listed 61 genera and 209 species of fleas from North America and the West Indies. In discussing the relationships of the Siphonaptera the authors take the view that they are derived along with the Diptera from a common ancestral stock. They regard fleas as being more ancient and more primitive than Diptera and classify them into six families. Owing to synonymic changes several of the names thus used will be unfamiliar to non-specialists. At the end of the paper is a very complete bibliography which takes into account the literature on these insects up to October 1940. A careful revisional paper of this kind is of wider interest than to North American workers only, and it is commended to the attention of students in Britain also.

Rubber-yielding Dandelions in Sweden

ACCORDING to the June issue of the *Anglo-Swedish Review* the scarcity of rubber in Sweden forced that country to evolve substitute products. The experimental production of synthetic rubber has been going on for some time, and its manufacture on a commercial scale has been commenced by a number of companies. Side-by-side with the work attempts are being made to cultivate rubber-yielding dandelions of the Russian type (*Taraxacum kok-saghyz*). Cultivation on a small scale started last year and this year it will be possible to extend somewhat the sown area by means of seed obtained from these cultivations. It is estimated that by the end of 1944 Sweden will have at its disposal about 300 kilograms of seed and a crop of about 27,000 kilograms of one-year old root and 38,000 kilograms of two-year old root in addition to a sown area of 230 hectares. The rubber content in the one-year old root is estimated at 2 per cent and in the two-year old root at 3 per cent. The rubber obtainable from this crop will be very insignificant, but enough for further experiments to ascertain the quality of this rubber and its susceptibility for various purposes.

Future of Technical Colleges

Messrs. R. M. Barrer and J. P. Andrews have written in connexion with their letter in NATURE of July 17, p. 80, on this subject. The phrase "relieve the Technical Colleges of the necessity of preparing students for External University Degree" appearing in quotation marks implies that it was quoted from the report of the Board of the Institute of Physics. This is not the case, so quotation marks should not have been used.

The Night Sky in August

NEW moon occurs on August 1d. 04h. 06m. U.T. and full moon on August 15d. 19h. 34m. New moon occurs again on August 30d. 19h. 59m. The following conjunctions with the moon take place: August 2d. 05h., Mercury 0·5° N.; August 4d. 08h., Venus 7° S.; August 22d. 16h., Mars 4° N.; August 24d. 18h., Saturn 3° N.; August 28d. 21h., Jupiter 0·9° N. The following occultations of stars brighter than magnitude 6 occur: August 12d. 21h. 38·9m., 121 B. Sgr (*D*); August 20d. 23h. 09·4m., ξ^2 Cet (*R*); August 23d. 03h. 02·0m., γ Tau (*D*); August 23d. 04h. 09·7m., γ Tau (*R*); August 23d. 12h. 36·8m., ϵ Tau (*D*). The times are given for Greenwich, and *D* and *R* refer to disappearance and reappearance respectively. Mercury is an evening star, reaching its greatest eastern elongation on August 29, on which day it sets at 19h. 23m. At the beginning of the month it sets about 20 minutes after sunset. Venus is stationary on August 13 and sets at 19h. 50m. on that day. At the beginning and end of the month the planet sets at 20h. 45m. and 18h. 10m. respectively and is visible as an evening star during the first part of August. Mars moves from the constellation of Aries to Taurus early in August. The planet can be seen as a morning star and rises at 23h. and 21h. 50m. at the beginning and end of the month respectively. Jupiter is too close to the sun to be observed in the early part of the month. At the end of the month the planet rises at 3h. and sets nearly an hour before sunset. Saturn, in the constellation of Taurus, is a morning star and rises at 1h. and 23h. at the beginning and end of the month respectively. Times are given approximately for the latitude of Greenwich. In addition to the phenomena mentioned above, the following take place: August 4d. 17h., Mercury in conjunction with Regulus, Mercury 0·8° N.; August 17d. 07h., Mercury in conjunction with Venus, Mercury 6·1° N. The Perseid meteors will attain their maximum on August 10–12, but moonlight will interfere with the observations until midnight.

Eclipses. There will be an annular eclipse of the sun on August 1, invisible at Greenwich. It will be visible as a partial eclipse in Australia and its magnitude will be 0·69 at Melbourne, where it will commence and end at 4h. 02m. and 6h. 54m. respectively. A partial eclipse of the moon will take place on August 15 and will be partly visible at Greenwich. The beginning will be visible generally in the western part of the Pacific Ocean, Antarctica, Australia, New Zealand, the Indian Ocean, Asia, south-eastern Europe and Africa, except the north-eastern part. The circumstances of the eclipse are given below:

Moon enters penumbra	Aug. 15d.	16h.	58·0m.
,, ,, umbra	15	17	58·5
Middle of Eclipse	15	19	28·4
Moon leaves umbra	15	20	58·1
,, ,, penumbra	15	21	58·3

Announcements

THE University of Oxford has conferred the honorary degree of D.Litt. on Prof. A. L. Bowley, acting director of the University of Oxford Institute of Statistics.

THE University of Leeds is to confer the following honorary degrees: *LL.D.*, Prof. H. S. Raper, Brackenbury professor of physiology in the University of Manchester; *D.Sc.*, Mr. E. V. Evans, chairman of the Gas Research Board.

AT the recent annual meeting of the Royal Society of New South Wales, it was announced that the Council has awarded the Clarke Memorial Medal for 1942 to Dr. W. L. Waterhouse of the University of Sydney in recognition of outstanding contributions in the sphere of natural science, particularly in plant pathology.

AT the annual general meeting of the Institute of Physics held on July 22, the following were elected to take office on October 1: *President*, Sir Frank Smith; *Vice-Presidents*, Mr. E. R. Davies, Dr. W. Makower and Mr. T. Smith; *Honorary Treasurer*, Major C. E. S. Phillips; *Honorary Secretary*, Prof. J. A. Crowther; *Ordinary Members of the Board*, Prof. J. D. Cockcroft, Mr. D. C. Gall, Dr. H. Lowery, Mr. D. A. Oliver, Mr. A. J. Philpot, and Mr. R. S. Whipple.

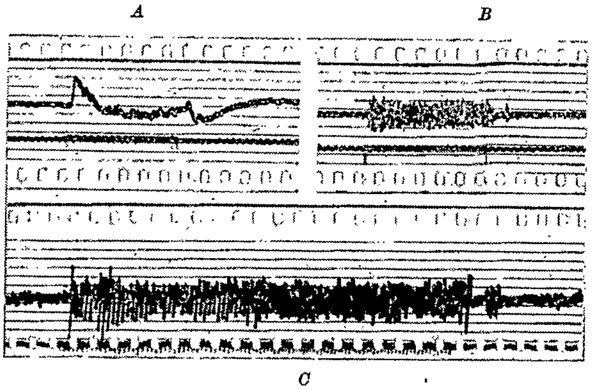
LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Electrical Responses from the Primary Acoustic Centre of the Frog

It has been shown that sound stimuli elicit electrical potential changes in the central auditory pathways in the cat[1,2]. We have studied these responses in the frog, using micro-electrodes, which permit of a more detailed picture in respect of at least some of the electrical phenomena.

The roofs of the skulls of isolated heads of *Rana temporaria* were removed and the preparations placed on cotton wool soaked in Ringer's solution. Potential changes were led off from the acoustic area in the dorso-latero-cranial part of the bulb by means of an isolated tungsten micro-electrode and an Ag-AgCl-electrode placed on the cotton wool bed, and led to a capacity-coupled 4-stage amplifier operating a cathode ray oscillograph, from which the deflexions were photographically recorded. Controls were made on the dead brain to show that no disturbing artefacts occurred.



A. Micro-electrode on the acoustic area of the frog. Higher frequencies not recorded. "On" and "off" effect at the beginning and after the stimulus, marked on the lower line. Time 1/50 sec. *B*. Impulses led off from the same spot, high frequencies recorded. Note the second group of impulses during the "off" effect. C. Same as 1 *B* but higher amplification, micro-electrode on a different spot. Sound stimulus 200/sec.

The curves obtained with the micro-electrode placed in the most superficial cell layers of the acoustic area revealed a certain amount of spontaneous activity (Fig. *C*), confirming previous findings[3]. The discharge was of a low voltage (5–15 μV.) but clearly distinguishable from the noise-level. Sound stimuli, produced by a loud-speaker, fed from a neon lamp oscillatory device, elicited typical changes in the picture, though the area from which these responses could be obtained was rather small. With the use of a frequency filter and a time constant of the amplifier of the order of two seconds it was possible to record slow waves at the beginning and immediately after the conclusion of the stimulus, appearing as 'on' and 'off' effects. Effects of this kind are shown in Fig. *A*. The latent period for the appearance of the first spike-like deflexion was 20–40 m.sec. The 'on' and 'off' effects were always of opposite signs and, in our arrangement, had an amplitude of up to 100 μV. When the amplifier was tuned for higher frequencies a sudden outburst of impulses in rapid succession occurred at the onset of the sound stimulus, and lasted slightly longer than the latter. During the 'off' effect a definite inhibition of the discharge could be observed. This was more distinctly borne out by curves recording the train of spikes when the amplifier was working with a short time constant, as illustrated in Fig. *C*. The spikes started after a latency period of 20–30 m.sec. corresponding to the appearance of the 'on' effect. The amplitude of the spikes remained practically unaltered during the stimulus, if this lasted less than 2 sec., but usually became gradually less during longer stimuli. As to the frequency of the spikes, it corresponded closely to the frequency of the sound stimulus, within the range studied in the preliminary experiments (200–500 cycles). A similar correspondence has been described previously for the acoustic nerve[1]. That the effect is not a microphonic one was shown by the latent period and by the 'off' effects described below. The 'spikes' shown in Fig. *C* do not seem to represent the activity of single fibres, since it has been found that the amplitude varies with the intensity of the stimulation. It therefore seems more probable that they are built up by the simultaneous activity of a group of fibres.

At the end of the stimulus the impulses continued for about 50 m.sec. at a diminishing amplitude. After this a short silent period ensued, followed by a short, but very distinct volley of spikes, lasting a few hundredths of a second and of about the same frequency as during the preceding discharge. After this volley the spontaneous activity was usually markedly reduced for some 50–100 m.sec. When slow waves only were recorded, as in Fig. *A*, a few waves occurred during the 'off' effect, which seem to correspond to the volley of spikes described above. The silent period and the secondary volley of spikes were usually well marked after short stimuli (about 1 sec.) but may be absent after stimuli of 10–30 m.sec. duration. There was no evident correlation between the duration of the stimulus and the amplitude of the 'off' wave. The latter, however, like the other effects described, is correlated with the intensity of the stimulus.

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Relation between Experiments on Isolated Muscle and Isolated Strips of Myosin

Astbury and Dickinson[1] have shown that isolated strips of myosin from unstriated muscle show thermal contraction below 40° C. It is interesting to note that living muscle also begins to show increased tone at this temperature[2,3]. The effect of alkalis is to increase the contraction of myosin; in actual muscle tone is increased in alkaline solutions[4–7].

These observations are interesting in view of the elation between isolated, dead myosin and that of ving muscle, and also because of their bearing on he nature of muscular contraction. A substance ay act directly on the contractile mechanism of the uscle, or indirectly through the excitability system. f any agency affect myosin and muscle identically, hen it acts on the contractile mechanism directly, hough it may also affect the excitability mechanism. rise in temperature will directly affect the conractile mechanism.

Contraction of myosin and of muscle under similar onditions suggests the possibility of muscular conractions without oxygen consumption. When untriated muscle is immersed in solutions containing arium chloride, a reversible contraction occurs hich persists when the muscle dies[8]. This contraction s not accompanied by an increase in oxygen conumption[2]. Barium chloride solutions do not harm he muscle, which may remain alive in such an nvironment for several hours. The persistence of he contraction after death of the muscle is noteorthy.

If the normal contraction of muscle be due to the ontraction of myosin molecules, then the internal riction between molecules would increase when the muscle contracts[5] and the viscosity of muscle would hus increase. Gasser and Hill[9] found that the iscosity of striated muscle increases during conraction. Such increase in viscosity should then be bolished by stretching, which should undo the intramolecular transformation. In Mytilus muscle, stretchng decreases viscosity, as shown by its effect on the ate of change of length[5,3,2]. It is generally considered hat unstriated muscle, which is usually tonically ontracted, is more viscous than striated muscle.

The question then arises as to why in one type of ontraction there is an increase in oxygen consumpion and not in the other. It might be suggested hat, when accompanied by an increase in oxygen sage, contraction is maintained by an unstable metabolite, which, by combining with myosin, induces attraction between component parts. When nstriated muscle contracts without increase in oxygen consumption, distortion of the myosin molecule may cause attractive forces to come into play without any intervening agency.

When unstriated muscle is immersed in sucrose or glucose solution, it contracts, but its oxygen consumption decreases[6,2]. When the muscle is reimmersed in Ringer solution, it relaxes and its oxygen consumption increases. In this connexion it is interesting to note that the oxygen consumption of isolated unstriated muscle, which is usually found in a state of tonic contraction, is less than that of isolated striated muscle, which is usually relaxed.

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A Modification of the Gemmell Single Cyst Technique for the Potato Strain of the Eelworm *Heterodera schachtii* Schmidt

THERE is little doubt that the single cyst technique recently described by Gemmell[1] is a considerable advance on methods previously used in work with the potato strain of the eelworm *Heterodera schachtii*. As it is probable that the method will eventually be widely used, it was thought worth while to describe a simple modification of the method which, it is thought, possesses certain advantages over the original.

In the Gemmell technique, each cyst is kept in a single drop of potato root excretion on a cover-slip which rests on a glass ring standing in a Petri dish. The drops of excretion are prevented from evaporating by a sheet of moist filter paper lining the floor of the Petri dish, and half-inch diameter holes, on which the glass rings stand, are punched in the paper so that counts of the larvæ can be made by observation through the clear areas; when counts are made, the under surface of the cover-slip has to be wiped to remove condensed moisture, and the slip is then replaced on the glass ring. Each 12 cm. petri dish accommodates five cysts. Clearly, the examination of several hundred cysts involves considerable manipulation; the following method is much more economical of labour, and, incidentally, of glassware too.

Circles are 'stamped' on a Petri dish by means of a half-inch diameter ring first dipped into melted 'Vaseline'; a single cyst and a drop of root excretion are added to each circle, as in the Gemmell technique, but the chamber is kept moist by filter paper adhering to the *lid* of the Petri dish. The advantages of this method are: (1) 25 cysts are easily accommodated in a single 12 cm. Petri dish and larval counts are therefore easier; (2) the problem of moisture condensation is eliminated.

Gemmell transfers each cyst to another cover-slip after each larval count; it is doubtful if this is really necessary, at least with the modified technique, for the larvæ can be removed with certainty with a bent pipette, and fresh root excretion added. The 'Vaseline' circles are easily made, and, in contact with root excretion, they retain their sharp outline for weeks. Paraffin wax can be used instead of 'Vaseline', but the latter is more easily used owing to its lower melting point.

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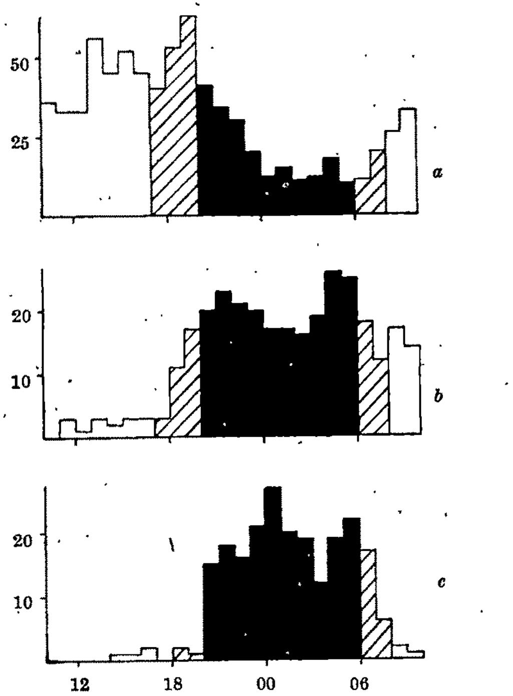
Diurnal Activity of Three Insect Pests of Stored Products

I WAS recently enabled, through the kindness of the mill staff, to carry out a series of observations over a 24-hour period in a certain flour mill. The mill contained bags of infested spaghetti which had been stacked up in preparation for fumigation. The stacking was done three days before the observations were made, and it was assumed that any disturbing effect of moving the bags during stacking had died down.

The animals dealt with were *Ephestia kühniella* Zell. larvæ, *Ptinus tectus* Boie. adults and *Calandra granaria* L. adults. The observations consisted of hourly counts of the numbers of animals active on the surface of a certain area of the spaghetti bags. An electric torch was used for observing the animals, and it was allowed to play on them for as short a time as possible, so as to minimize its disturbing effect. During the mill's working hours, 8 a.m.–5 p.m., electric lighting was on, which together with daylight coming in from open doors gave dim light. Some machinery was in action, causing a certain amount of vibration. Readings of temperature and relative humidity were made directly after each count. The temperature only varied from 11·5 to 12·5° C., while the humidity was between 70 and 80 per cent throughout.



DIURNAL ACTIVITY OF (*a*) *Ephestia kühniella*, (*b*) *Calandra granaria* AND (*c*) *Ptinus tectus*. ORDINATES, NUMBERS OF ANIMALS ACTIVE; ABSCISSÆ, TIME B.S.T. BLACK-OUT PERIOD IS SHOWN IN BLACK; PERIOD BETWEEN BLACK-OUT AND MILL WORKING HOURS IS SHADED.

The results are shown in the accompanying figure. Those for *Ptinus tectus* confirm in "the field" results obtained by Bentley *et al.*[1] in laboratory conditions. *Calandra granaria* shows a similar pattern of activity. In *Ephestia kühniella* the reverse pattern is shown, activity being greatest during the daytime. In Ptinus and Calandra activity and exposure are parallel; during the day-time when the animals are inactive they are hidden away in cracks, under bags, etc. The reverse is true for Ephestia larvæ; during the night, when activity is least, many animals are exposed. They lie motionless on the surface of the bags, and are easily visible. The largest number of caterpillars, counting both active and inactive, was seen exposed on the surface of the bags shortly after dusk.

From casual observations in various parts of the mill throughout the night it was clear that the following species are also more exposed during the night: *Tenebrio molitor* L. (larvæ), *Oryzœphil* *surinamensis* L. (adults), *Ptinus tectus* Boie. (larvæ *Ephestia kühniella* Zell. (adults), *Lyctocoris campestr* F. (adults and nymphs).

These observations confirm the impression gene ally held that insects in stored products are mo obvious by night than by day. This is true not onl for those which show greatest locomotory activit by night, but also for caterpillars of *Ephestia kühniell*

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Tablet Absorption and Ghost Formation

THE formation of ghosts in compressed tablets o synthetic œstrogens during subcutaneous implantation has been previously described[1]. These structure are probably composed mainly of scleroprotein forme by a reaction between the synthetic œstrogen an soluble protein in the tissue fluid. The phenomenon ha also been observed in tablets of œstrone, œstradiol an pregneninolone in the human[2] and in a tablet o testosterone propionate in a bull. It has since bee found that ghosts are formed *in vitro* in hexœstro tablets incubated in blood serum and plasma and i aqueous solutions of various proteins.

Further absorption studies with compressed tablet of pure hexœstrol, carried out primarily with th object of elucidating the role of ghost formation i tablet absorption, have led to the following conclusions.

Compressed hexœstrol tablets, of the type used possess a labile fraction (that may or may not b located in the surface zone) which is quickly lost o subcutaneous implantation or incubation with bloo plasma or with distilled water. The remaining portio is much less soluble. It was reported previously[3] tha tablets re-implanted subcutaneously after a previou *in vivo* implantation undergo less absorption in a give time than unused tablets. It has now been found tha this also applies to tablets which have been incubate in blood plasma, and, what is most significant, in distilled water. It thus seems that the reduced initia absorption on re-implantation must be due to th loss of the labile fraction during the previous implantation and not, as was once believed[3], to th presence of a pre-formed ghost in the tablet.

In consequence of the labile fraction, absorptio curves for 1,000 mgm., 500 mgm. and 250 mgm tablets in the bovine, goat, rabbit, rat, guinea pi and pigeon show two phases. There is an initia phase of rapid absorption, after which the curve bend sharply and absorption proceeds at a linear but reduced, rate. The linear section of such a curv makes, on extrapolation, a positive intercept on th vertical (absorption) axis, from which the weight o the labile fraction may be estimated. On the othe hand, curves for 50 mgm., 25 mgm. and 15 mgm tablets in the rat are linear and pass through, or ver near, the origin.

Because of ghost formation, apparent absorptio values, determined by weighing tablets before an after implantation, are in all cases lower by th weight of the ghost than the true values. On extrapolation, therefore, true absorption curves mak larger intercepts on the vertical axis than appare urves. The true absorption curves for small tablets 1 the rat are thus probably of the same form as ose for larger tablets, though here the difference ade by the ghost correction has been found to be uch less than for large tablets. Even after applica ion of the ghost correction, such curves make only mall intercepts on the vertical axis, indicating that or reasons at present unknown, the labile fraction is ss important in the smaller classes of tablet than in ablets weighing 250 mgm. and upwards.

The characteristic absorption rate for tablets of ny given weight is represented by the slope of the bsorption curve during the linear phase. Absorption ates per mm.^{2} of tablet surface, for tablets of various izes implanted in different animals, were approxi nately constant, provided that the tablets were not oo large in relation to the size of the animal, showing hat absorption rate is proportional to surface area. n the rat, the linear absorption rate of large tablets vas found to be either very much reduced (500 mgm. ablets) or zero (1,000 mgm. tablets), possibly because of saturation of the body fluids or local tissues with exœstrol absorbed during the initial phase.

These experiments, which will be more fully lescribed elsewhere, show that ghost formation is not esponsible for the fall in absorption rate observed vith large tablets shortly after implantation, but provide no answer to the question whether or not he presence of the ghost has any influence on the inear absorption rate.

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July 3.

Folley, S. J., NATURE, 150, 403 (1942).

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Propagation of Potato Seed Tubers from Stems

MENTION has been made by Dr. N. Polunin[1] of he practice of propagation of potatoes for seed ubers from what are described as 'tops'. This work as been developed in the U.S.S.R. recently by Prof. Lysenko. The method was employed in Great Britain during the War of 1914–18, though on a smaller scale. The term 'tops' has caused some con fusion among British workers, for it refers to the severed rose or top ends of large-size tubers and not, as might be supposed, to the aerial stems of the plant. Tops, shaws or haulms are common names in Great Britain for the stems and thus a wrong impression has arisen.

Propagation for seed tubers is possible, however, from pieces of the aerial stems, and my observations are given below because they may be of value where there is a critical need for the largest quantity possible of seed tubers, as in the U.S.S.R. It is also desirable for breeders of potatoes to multiply the stocks of a new and valuable variety at as great a rate as possible without causing any deterioration in vigour.

When early varieties such as Arran Pilot are lifted, in June or early July, the strongest and healthiest stems are collected and treated in the following manner. The roots and the tip ends are cut off with a sharp knife, the leaves are also stripped by the same means, but any small axillary shoots are left. The stem is then cut transversely into two separate halves, so that each half possesses not less than three nodes. If these stem pieces are planted in moist soil at a depth of about 5–7 cm. they will give rise to small plants and to a crop of seed-size tubers before winter. The stem pieces are, however, susceptible to attacks by slugs and should be treated with a suitable deterrent where these pests are present.

In the course of this work it is observed that, if the axillary shoots are removed or if they are very minute, small tubers of a perfectly normal appearance develop in the axils in about ten days. This occurs not only in the soil but also where the stem pieces are left in the dark, in boxes and in a cellar preferably covered by damp sand or moss. Growth is continuing after three weeks and there is reason to suppose that the majority of the tubers will reach the size of chats, which are often planted in the field in Great Britain.

This latter method presents possibilities for the propagation of second early and maincrop varieties, where it is too late in the season, when they are lifted, for the stems to be replanted in the earth. Darkness appears to be essential to normal tuber formation and it is necessary to avoid any place which is too damp and badly ventilated or, on the other hand, too dry. The former condition may cause rotting and the latter a shrivelling of the stem piece.

Investigations are still in progress, but it is desirable that the matter should be made known before the present season is too far advanced for others to try these methods.

G. H. BATES.

The Farm Institute,
Penkridge. July 13.

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[1] NATURE, 151, 421 (1943).

Distribution of Catalytically Active Centres on Surfaces

THE autopoisoning of catalytically active copper in dehydrogenating ethyl alcohol above 280° C., previously reported[1], has been further studied. Assuming a linear law of variation of the velocity constant k_ε of the poisoning with the heat of activation ε on the distribution[2] of centres of activity on the surface over the narrow range of values of ε which determine the reaction velocity in the form

$$k_\varepsilon = k_0 (a + b[\varepsilon - \varepsilon_1]),$$

where ε_1 is the lower limit of the value of the heat of activation, the equation for the decay of reaction velocity with time in the auto-poisoning of the distribution of active centres becomes

$$v_t = v_0 \ \frac{e^{-at}}{1 + \beta t},$$

where $\frac{\beta}{\alpha} = \frac{b}{a\lambda}$, and λ is the exponential factor giving the decrease in the reactivity of centres with heat of activation as the heat of activation rises over the distribution.

Now $\lambda = \frac{1}{RT} - \frac{1}{h}$, or according to Cremer and Schwab[3], $\lambda = \frac{1}{RT} - \frac{1}{RT_e}$, where T is the absolute temperature of reaction, and T_e is the absolute temperature at which the groups of atoms with strong external fields are frozen in equilibrium. Thus

$$\frac{\beta}{\alpha} = \frac{b}{a\left(\frac{1}{RT} - \frac{1}{h}\right)} = \frac{bR\,TT_e}{a(T_e - T)},$$

giving in the region of temperature below T_e, provided $\frac{b}{a}T$ does not change appreciably, that $\frac{\beta}{a}$ $(T_e - T)$, that is, β/α multiplied by the difference in centigrade temperatures, should be approximately constant, or that the ratio should rise rapidly on approaching the apparent temperature at which the groupings of atoms have been frozen.

Measurements of the rate of dehydrogenation in this region have given the following preliminary results :

(*a*) the formula fits the curves reasonably closely ;

(*b*) both α and β and the ratio β/α rise as the temperature of reaction increases towards T_e ;

(*c*) the product $\frac{\beta}{a}$ $(425 - T°\ \text{C.})$ is approximately constant.

Temperature (T °C.)	$a/2{\cdot}3$	$\beta/2{\cdot}3$	β/a	$\frac{\beta}{a}(425 - T)$
300	0·00309	0·00524	1·73	216
350	0·00541	0·01648	3·04	228
365	0·01265	0·04505	3·56	214

The results are also suggestive in that the apparent rise in the heat of activation appears to be shown in the α and β constants themselves. The active surface in these experiments appears to have been frozen at a temperature of 425° C., which gives a value of $1/h = 7{\cdot}2 \times 10^{-4}$ in the formula

$$\delta n = Ae^{\varepsilon/h}\delta\varepsilon\,;$$

this compares with a mean value of $6{\cdot}6 \times 10^{-4}$ directly measured in previous experiments[2].

The positive sign of β in the results leads to the conclusion that the more active centres poison more slowly than the less active ones. Further work is proceeding, but it does appear that this is a rare case in which information about the distribution of active centres may be obtained from measurements of the decay of reaction velocity at a series of temperatures in the region below T_e.

I beg to acknowledge with thanks a grant from the Dixon Fund of the University of London. A full account will be published later.

F. H. CONSTABLE.

St. Johns, Cashio Lane, Letchworth, Herts.
June 16.

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[1] Constable, *J. Chem. Soc.*, 2995 (1927).

[2] Constable, *Proc. Roy. Soc.*, A, **108**, 355 (1925).

[3] Cremer and Schwab, *Z. physik. Chem.*, A, **144**, 243 (1929). Schwab, *Z. physik. Chem.*, B, **5**, 406 (1929). Cremer, *Z. physik. Chem.*, A, **144**, 231 (1929).

Marine Biology in the West Indies

In his recent communication[1] in which he urges the establishment of biological research stations in the West Indies, Dr. V. J. Chapman has raised a matter of prime interest to all British biologists. My interests are in marine biology but, before proceeding to elaborate the arguments for the establishment of a centre of marine research in the West Indies, it may be stated in general that the ideal training of all biologists should include some experience of tropical conditions. This has long been recognized in the United States, where admittedly access to tropical regions has been easier. But in days when hundreds or thousands cross the Atlantic weekly by air, Great Britain is effectively little farther from the West Indies than are the northern and western areas of the United States. We are promised great colonial development after the War and this project of Dr. Chapman's, whereby the universities of Great Britain can co-operate in the prosecution of fundamental biological research in the West Indies (and, it ma be hoped, farther afield also), is one of the obviou ways in which this development may be furthered.

Marine biological research in the southern Nort Atlantic has suffered a considerable setback owin to the closing down of the two marine stations a Bermuda and the Tortugas. The former, it is hoped will be re-established after the War, but its obviou function is the study of the waters of the Gulf Strea and to act as a link between the oceanographica work at Woods Hole and at Plymouth. It is destine to be an important Anglo-American link and woul in no way fulfil the functions of, or in any wa compete with, a marine station in the West Indies.

With the abandonment by the Carnegie Institutio of its laboratory at the Tortugas there is now n centre of marine research in the Gulf of Mexico o in the Caribbean Sea. It is well known that, bu for the untimely death of Dr. A. G. Mayor, thi station would probably long ago have been transferred to some more accessible site. Dr. Mayo certainly hoped to see it transferred to Montego Ba in Jamaica (one of the sites suggested by Dr. Chapma in his letter). Whether the Carnegie Trustees hav any plans for the continuance of tropical marin research after the War remains to be seen ; but i is at least possible that they might be prepared t co-operate in the establishment of a station i Jamaica.

The possibilities of a tropical marine station readil accessible to British workers are great indeed. I was the common impression of all my colleagues o the Great Barrier Reef Expedition that our intensiv year of work, when we attempted in the time available to apply the methods of Plymouth and o Millport to the study of coral reefs, did little mor than reveal to us the endless diversity of problem that the conditions of tropical marine life present t the inquiring mind. The diversity of forms of life and often the size of individual species, are muc greater in tropical waters ; the speed of developmen and growth and the intensity of environmenta factors greater than in temperate seas.

It is hoped that after the War the Colonial Offic will establish a fisheries service. It will need station in the West Indies, but more than that i will want a centre for the training of fisheries officer for services elsewhere in the tropical Atlantic and i the Indian and Pacific Oceans also. Where bette than in the West Indies, where direct contact coul be maintained with the parent British institution a Plymouth and also with the British universities Moreover, a colonial fisheries officer is none th worse for some knowledge of the characteristics o the terrestrial fauna and flora of the tropics whic could be obtained from the land station which Dr Chapman also suggests should be established.

Strong support, it is felt, should come from Britis universities for this project. Here, at Bristol, we hav historical connexions with the West Indies an still retain the major part of its now diminished trade Although I write this letter in a purely privat capacity I am confident that any appeal made t the universities on this matter would find here particular welcome and response.

C. M. YONGE.

Department of Zoology,
University,
Bristol, 8.
July 16.

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[1] NATURE, 152, 47 (1943).

EDUCATION AND TRAINING FOR ENGINEERS

ON March 19, 1942, a paper entitled "A Critical Review of Education and Training for Engineers" was read in London before the Institution of Electrical Engineers by Dr. A. P. M. Fleming. The paper was prepared by a sub-committee of the Post-War Planning Committee of the Institution, with Dr. Fleming as its chairman, and it received an extended notice in NATURE of May 2, 1942 (p. 482). Based on this paper and the subsequent discussions, a 22-page report on "Education and Training for Engineers" has now been issued by the Post-War Planning Committee with the authority of the Council of the Institution, with the expressed hope that it may be of assistance to those concerned in the problems of post-war reconstruction in Great Britain.

Dealing first with craftsmen and foremen, it may be said that there is general agreement on the need for measures which will lead to improvement in the status of the craftsman. To this end the following recommendations are made. More care should be exercised in the selection of entrants to craft training courses. This should be the responsibility of panels representing wider interests and experience than those of the employer alone. There should be a probationary period for all craft apprentices during which provision would be made for transfer to more suitable employment where necessary. The apprenticeship should commence with a period in a special apprentice workshop where the elements of the craft would be acquired under the guidance of experienced instructors. Where possible, these workshops should be a part of the industrial organization, but co-operation of the local technical colleges will be necessary where this is impracticable. Subsequent practical training should be organized, and definite responsibility for the training course should be accepted by each employer. Part-time day release should be granted for general education and for vocational instruction. The combination of workshop and classroom instruction should be organized on nationally recognized ines and a 'craftsman certificate' should be instituted. Subsequent part-time courses should be provided eading to certification for foremanship. The school-eaving age should be raised, and the full-time education received up to this age and the part-time education received afterwards should both be planned on as broad a basis as possible. Thus every facility would be afforded for development, not only in the craft or trade but also in the best use of leisure; and transfer to other types of work would be simplified for the man who so desires.

As to student apprentices, this title is intended to cover those whose practical training and technical education are combined on a part-time basis, who will become draughtsmen, designers, etc., and may attain some of the highest executive positions. For such it is recommended that organized schemes of practical training should be instituted, or participated in, by all employers of student apprentices, and that recognized national standards should be established. Part-time day release for study, both general and technical, should be compulsory, and this release should be for not less than one full day per week. Attention to technical matters at the expense of the study of broad scientific principles should not be permitted in the early stages of the course. Some part-time evening instruction should also be available, but this should not be made compulsory. The present schemes of Ordinary and Higher National Certificates should be continued and developed and should form an integral part of student apprenticeship. Consideration should be given to making teaching in technical schools, institutes and colleges more attractive as a profession. The facilities which are available for technical teachers to return to industry for short periods, to renew their industrial experience, should be extended. Technical teachers should receive instruction in the art of teaching.

For university trainees it is recommended that full-time university courses should be made available to anyone who has the ability to obtain full benefit from them. There must be no financial barrier to entry. Schemes similar to the present State bursary scheme should be implemented after the War, provision being made for increased transfer from National Certificate to university courses. University engineering schools should cease to treat all students as potential high-grade scientific or technical workers; those who are not should receive instruction in economics, law and social science in place of the more advanced technical instruction. It is the duty of the university to equip men for leadership and not merely to impart advanced technical and scientific knowledge. University engineering students should devote part of the two shorter vacation periods to tutorial classes and part of the longer vacation period to the acquisition of practical experience. A period of the order of one year should be spent in gaining experience of industry before proceeding from school to the university. All university engineering graduates should be given a course of practical training of a broad character.

Lastly, in respect of 'post-advanced' students it should be remarked that the professional engineer must acquire specialized knowledge of the branch of engineering in which he is engaged, and the university graduate must acquire practical experience before he is able to apply his academic knowledge usefully. To this end it is recommended that postgraduate work at universities should be further developed, and that 'post-advanced' courses of lectures by recognized authorities should be provided locally on specialized branches of engineering practice. Technical colleges should extend the provision of 'post-advanced' courses in such subjects as economics, workshop organization and management, industrial management and business practice. These and similar subjects should be studied when the student is sufficiently mature to appreciate them and is likely to be able to make use of them. This is particularly important in the training of men who have been selected as potential executives. Such men should also be afforded opportunities of acquiring experience in administration.

Subsequent to the above recommendations, the report presents the bases upon which they are made, these being as follows: an outline of the pre-war engineering education and training system for England and Wales, and the essential elements of a satisfactory post-war system, which latter embody vocational guidance and selection, training of engineers, training of craftsmen, and the selection and training of teachers.

In its concluding paragraph, the report strikes the real keynote of success, urging that "the progress of engineering—in fact that of any human activity—depends on personnel. It is therefore essential in the national interest to secure the proper recruitment and training of personnel for the engineering industry, not only for the higher professional ranks but also for every grade of worker. It should be a fundamental principle in dealing with engineering personnel to ensure that every individual is so trained that, whatever the work on which he is employed, he can give service in the most efficient manner possible".

SCIENCE IN SOVIET RUSSIA

In his account of "Science in Soviet Russia" in the Trueman Wood Lecture before the Royal Society of Arts on April 14, Mr. J. G. Crowther said that the place of science in Soviet philosophy is the most important motive in the development of science in the Soviet Union.

Reviewing the development of the new physical research institutes, Mr. Crowther pointed out that these were not built until the men to run them had already been trained. Following that of the Ukraine opened at Kharkov in 1930, others were founded at Dniepropetrovsk, Sverdlovsk, Tiflis and other centres. The existence of these new scientific institutes, especially in the east, has been of great importance during the present War. Sverdlovsk, for example, received important sections of the Soviet Academy of Sciences when Moscow was threatened. The new institutes have special lines of research appropriate to the needs of the locality. The Physico-Technical Institute at Kharkov had large research departments in high-tension physics and low-temperature physics. At Dniepropetrovsk and Sverdlovsk, special attention was given to metallurgy, the latter Institute serving the scientific needs of the metal industry of the Urals.

In the planned development of science in the U.S.S.R., Mr. Crowther said that at least as much importance is attached to human as to natural resources, and the founding of special institutes for men of outstanding ability has been a feature of it. In such planning, the importance of the Academy of Sciences has steadily increased and it is now directly responsible for this work to the Supreme Soviet. The Academy determines the general lines of scientific work in accordance with the needs of the State and possibilities in subjects and personalities. It sees that balanced attention is given to all sides of science, that no important branches are neglected and overlapping is reduced. Moreover, such planning is a mutual process of adjustment in which ideas flow equally from the top and the bottom.

The plan of research for 1943 is mainly directed to the improvement of war industries and armaments (see Nature, January 30, p. 129). Geologists and geographers are engaged on the exploration and study of new sources of oil, ores and minerals, especially in the Urals, West Siberia, Kazakhstan and the Middle Volga regions. Agricultural science will be devoted to efforts to increase the yield of cereal and industrial crops such as rubber-bearing plants, potatoes and beet. Technologists are to develop the use of industrial gas and the gasification of new forms of fuel, so that local fuels can be utilized and long hauls reduced, in addition to research on aircraft, radio, weapons, etc.

After a brief account of some of the achievements of Soviet science, Mr. Crowther said that the spirit of the Soviet men of science rather than the impressive number and equipment of Soviet scientific institutions is the chief quality of Soviet science. Th atmosphere of youth is striking and the planning o the research and the relation of the work of th Institutes to industrial and political affairs are th subject of continuous organized discussion. One o the achievements of Soviet technology has been th provision of an immense body of good technica officers for the Red Army. The problem of socia relations between the scientific and the ordinar worker has largely been solved, and the scientifi worker has great prestige due to philosophical an practical reasons, and he is relatively well paid enjoying also special holiday facilities as well as th health and education services available to ever Soviet citizen.

TIMIRIAZEV CENTENARY CELEBRATIONS

On June 3, the hundredth anniversary of the birth of the Russian naturalist and plant physiologist Klimenty Timiriazev, was celebrated throughout th Soviet Union, special celebrations being held in Moscow.

Timiriazev was a member of an impoverished nobl family living in St. Petersburg. The interest which Darwinism excited in him while he was a studen persisted throughout his life. In 1864 he published three articles about Charles Darwin and his teachings In 1870 he was elected to the chair of botany at St Petersburg Agricultural Academy and in 1877 he became, in addition, professor in the University o Moscow, where he lectured on the anatomy and physiology of plants. He was the author of many scientific works which have now been issued as a twelve-volume complete edition. Timiriazev devoted fifty years of scientific activity to the study o photosynthesis. His work was marked by exactitude perfection being his constant aim, and his improvements in technique won the admiration of many scientific men.

The main problem of Timiriazev's scientific work was the occurrence of photosynthesis in relation to regions of the solar spectrum—a problem furthe worked on by A. Richter, V. Lubimenko, and A Danilov. Timiriazev established the fact that disintegration of carbon dioxide proceeds most intensively under the influence of red light. Proceeding from the principle that accumulation of dry plan matter reaches its maximum in the blue regions o the spectrum, Danilov has extended Timiriazev's work to show certain relationships in aquatic plants Timiriazev was also interested in the pigmentary apparatus of photosynthesis. He also investigated field ecology; and the urge that incited even hi most academic work was the practical aim of helping the farmer, and thereby the people at large.

Timiriazev lived to see only the first two year of the Soviet Revolution, of which he declared himself to be a warm supporter. He not only left severa brilliant students including Dmitri Prianishnikov Sergei Kostichev, and his son Prof. Arkady Timiriazev but also acquired a remarkable reputation throughou Russia as a popularizer of science. Maxim Gorky asked how it was that in some snowy hamlet of th Kherson province, or so far away as Perm, Timiriazev was known, and his books frequently asked for Timiriazev's support of the Darwinian theory has ensured popularity for it in Russia.

These facts have emerged from accounts of the ntenary sent to us by Profs. Alexander Schneideran, Alexander Popov, Nikolai Williams, B. Shiskin, d others.

The Moscow centenary meetings included one held the Timiriazev Agricultural Academy (the oldest gricultural school in the Union) at which Alexander aramonov read a paper on "Timiriazev as the ounder of Russian Darwinists", and others spoke botanical problems. At a meeting in the Moscow cientists' Club, there were present members of the cademy of Sciences of the U.S.S.R., the Lenin cademy of Agricultural Sciences, University of oscow, and others. The Vice-President of the cademy of Sciences, Leon Orbeli, said in an introuctory speech that whole generations had been and ere being trained on the basis of Timiriazev's assic work "The Life of Plants". The eighty-yeard Victor Krasilnikov followed with a portrait of miriazev as a "Knight of Science". Krasilnikov d not simply relate, but re-lived the past, and entioned that one of Timiriazev's aims had een the creation of hundreds of experimental elds in every province. Timiriazev's activity d not find much practical support in pre-revoluonary times, but Trofim Lysenko pointed out hat much of the present Russian drive for increased gricultural production could be ascribed to the pirit of Timiriazev. At this meeting, congratulatory legrams were read from the Royal Society, the oyal Agricultural Society of England, and Rothmsted Experimental Station.

The Timiriazev Agricultural Academy is indeed laying a great part in Soviet agriculture. President alinin, chairman of the Presidium of the Supreme oviet, has expressed the desire that the influence of he Agricultural Academy should be extended to llective farms throughout the country and should nbrace all cultivation. Important steps in such xtension work have already been made in many istricts in European and Asiatic Russia.

In 1903 Timiriazev gave the Croonian Lecture, nd eight years later was elected foreign member, f the Royal Society. He was also doctor *honoris ausa* of the Universities of Cambridge, Glasgow and eneva, and was a member of the Edinburgh and anchester Botanical Societies. These foreign memberships were and are a source of much pride the Russian people, and Timiriazev's statue in he centre of Moscow shows him robed in a Cambridge own.

CARNEGIE INSTITUTION OF WASHINGTON

YEAR BOOK No. 41 of the Carnegie Institution of Washington covers the year July 1, 1941–une 30, 1942, and in addition to the reports of he executive committee, the auditors and the resident, includes the reports of the departmental ctivities and co-operative studies. In regard to ar activities, the president states that the policy the Institution, in carrying on war research for he Government, has been to contribute the use its facilities, the services of its regular scientific aff and its regular overhead costs of providing dministrative services and the like. The Institution reimbursed for all additional out-of-pocket xpenses directly attributable to the research for overnment. In addition, it has loaned the services of some of its scientific personnel while retaining them on the pay-roll. In regard to finance, the favourable financial situation of the Institution which existed for three decades no longer persists, and for the first time in the history of the Institution the budget involves even a small predicted deficit. There is still some room for retrenchment, and a deficit appears for one reason because the annual grant from the Carnegie Corporation of New York is carried in a separate account since it is of a terminating nature. The downward trend of income from 1,695,900 dollars in 1936 to an estimated income of 1,175,000 dollars for 1943 if continued will, however, soon involve retrenchment of the regular operation of the departments.

Among the results of many investigations undertaken at the Mount Wilson Observatory, special reference is made to the increase in our knowledge of solar prominences, solar rotation and the general magnetic field of the sun through the application of powerful interference methods; to the analysis of the gaseous clouds of interstellar space and to the probable solution of the long-standing problem of the direction of rotation of the extragalactic spiral nebulæ. Activities of the Geophysical Laboratory and the Department of Terrestrial Magnetism have been directed so exclusively to war research that there is little to report. Priorities have, however, now been obtained for the materials necessary to complete the cyclotron at the Department of Terrestrial Magnetism, which is expected to be available for use during the coming winter. In the field of terrestrial sciences a number of reports of work on cosmic ray research at the Universities of Chicago and New York, the California Institute of Technology and elsewhere are included.

In the Division of Plant Biology further work has been carried out on the variables of the photosynthetic processes, structural elements in the higher plants and differences and relations in climatic races of flowering plants. Several projects have been completed on the influence of a desert environment on plant-growth, and it has been discovered that diatoms and related plants contain chlorophylls which are different from those of land plants. The Department of Embryology has continued its work along previous lines, and knowledge of the development of the human embryo has been pushed back about one week to the eighth day of gestation. Effective co-operation has been continued between the Department of Genetics and the Long Island Biological Association at Cold Spring Harbor. Detailed studies at the Department of Genetics of genetic effects caused by X-rays, ultra-violet rays and neutrons show consistent differences between the action of these radiations. Compared with gene mutations, fewer chromosomal breaks are caused by ultra-violet radiation than by X-rays, whereas the neutrons show a higher rate of chromosomal breaks than X-rays. Nearly six years study of the role of hormones in the regulation of the maternal instinct in rats has been completed by Dr. Riddle and his associates, who have found that the pituitary gland hormones play an important part in the production of stimuli that result in unlearned maternal behaviour. The Department has also co-operated with the Bureau of Plant Industry and the U.S. Department of Agriculture on problems arising from the war emergency, and is experimenting with the rubber-producing Russian dandelion and with fibre-producing hemp.

The small staff of the Nutrition Laboratory has been engaged in important war research in co-operation with groups at the Harvard Medical School. Projects under the Division of Historical Research have been of interest in supplementing the Government's programme of inter-American cultural relations. The knowledge possessed by the staff members of this Division with regard to geographical and economic conditions in Central America is also proving of assistance in connexion with the Government's war programme.

ACID NEUTRALIZATION IN INSULATING PAPERS

In the manufacture of paper-insulated condensers, impregnating materials are used to eliminate air pockets and to increase the dielectric capacity of the paper. With long use, particularly at high temperatures and under high voltages, traces of hydrochloric acid are liberated from chlorinated impregnants. The acid, and the salts formed by its reaction with the metal electrodes, ultimately decompose the paper and break down the condenser. This destruction is delayed by calcium, magnesium and other metals combined chemically with the paper which neutralize the hydrochloric acid.

An article by D. A. McLean (*Bell Lab. Rec.*, 21, No. 6; Feb. 1943) gives some of the results of an investigation carried out on the properties of Kraft and linen papers. Exchange reactions in cellulose materials do not take place in the principal constituent but in other organic materials with which cellulose is always associated, including lignin, pectic substances and pentosans. Differences in content of these minor components explain why papers differ so greatly in exchange capacity. Kraft paper, which is much superior to linen for condenser insulation, has several times the exchange capacity of linen tissue. In apparatus with which accelerated life-tests of condenser papers are carried out, condensers are heated in an oil bath and a continuous record made of the leakage current until the paper under test breaks down.

When aluminium electrodes are used in condensers made with paper impregnated with chlorinated compounds, decomposition of the dielectric proceeds from central nuclei about which the paper becomes partially carbonized. If the sample is dismantled after accelerated tests at high temperature and with D.C. voltage, these areas can be seen as brown spots. Under ordinary artificial light a photograph shows dark spots on a light background, but with ultra-violet light the spots fluoresce brightly.

Papers of high exchange capacity are capable of suppressing the formation of decomposed areas, and in two samples taken from a condenser after approximately equal periods of test at the same voltage, linen paper is shown to become thickly populated with decomposed areas which have grown from minute centres seen scattered through the sample, whereas Kraft paper shows only slight evidence of decomposition. More severe conditions of test are required to produce serious deterioration in the Kraft paper.

Superiority of Kraft paper as a dielectric is illustrated by comparing the energy losses at elevated temperatures in condensers made with this material and with linen. The lower power factor in Kraft paper is due to the binding of ionic material by its base exchange properties, which decreases the A losses. Values given in the article were determin at low potential gradients, under which conditio ionization is most readily detected by A.C. measu ments. Condenser papers of high exchange capaci reduce leakage current; and typical results obtain with linen paper under accelerated test conditio show a rapid increase of leakage and dielectric failu after 40 hours. In contrast, Kraft paper has a mu more stable leakage current and a life of 350 hou as its high base exchange capacity suppresses deco position. These studies of exchange reactions condenser papers impregnated with chlorinat compounds have led to the development of stabilize which extend the life of condensers, under stat severe test conditions, to several thousand hours.

APPOINTMENTS VACANT

Applications are invited for the following appointments on before the dates mentioned:

Head of the Electrical Engineering Department—T Registrar, Technical College, Sunderland (August 6).

Lecturer (man or woman) in Chemistry in the Croydon Po technic—The Education Officer, Education Office, Katharine Stre Croydon (August 6).

Speech Therapist (full-time)—The Secretary for Educati Education Offices, York (August 6).

Graduate Assistant Master to teach Engineering Drawing the Middlesbrough Technical School for Boys—The Director Education, Education Offices, Middlesbrough (August 7).

Teacher of Mining Subjects in the Denbighshire Techni College, Wrexham—The Director of Education, Education Offic Ruthin (August 7).

Assistant Master (preferably a Graduate with works experien to teach Technical Drawing and Mathematics in the Sunderla Junior Technical School—The Director of Education, Educat Offices, Carlton House, Mowbray Road, Sunderland (August 9).

Assistant to teach Mathematics and other Junior Engineer Subjects—The Principal, County Technical College and School Art, Newark, Notts. (August 9).

Lecturer in Mathematics in the Constantine Technical Colle Middlesbrough—The Director of Education, Education Offic Middlesbrough (August 14).

Head of the Department of Child Development in successi to Dr. Susan Isaacs—The Secretary, University of London Instit of Education, at University College, Nottingham (August 14).

Lecturer (temporary) in Physics—The Acting Secretary University Court, The University, Glasgow (August 15).

Assistant Lecturer and Demonstrator in the Physiolo Department—The Secretary, The University, Birmingham (Aug 18).

Lecturer (temporary) in Chemistry—The Registrar, Univers College, Southampton (August 25).

Professor of Physiology, a Senior Lecturer in Anatomy, a a Senior Lecturer in Physiology, in the University of Ota Dunedin—The High Commissioner for New Zealand, 415 Stra London, W.C.2 (August 31).

Chemist and Assayer on the establishment of the South Afric Mint, Pretoria—The Secretary, Office of the High Commissioner the Union of South Africa, South Africa House, Trafalgar Squa London, W.C.2 (August 31).

Heads of the Departments of Physiology, Medicine, a Surgery—The Bursar, Royal Veterinary College and Hospital, The University, Reading (October 1).

Chair of Naval Architecture—The Acting Secretary of Univ sity Court, The University, Glasgow (October 4).

Engineering Workshop Instructor for service in the Bu Junior Technical School and Bury Municipal Technical College (Ev ing Classes)—The Director of Education, Education Offices, Bury

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Great Britain and Ireland

Young Workers and their Education: Providing the Right Ty of Education and Problems of Release from Work. A Report o Conference held at the College of Technology, Manchester, April 15 1943, under the auspices of the British Association for Commer and Industrial Education. Pp. 40. (London: British Associat for Commercial and Industrial Education.) 1*s*.

Geological Survey of Great Britain: England and Wales. Wart Pamphlet No. 33: Glauconite Sand of Bracklesham Beds, Lond Basin. By Dr. Kenneth P. Oakley. Pp. 28. (London: Geolog Survey and Museum.) 1*s*. 6*d*.

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RESEARCH AND PLANNING

THE planning of research in Great Britain and the efficient utilization of the scientific resources of the country have come increasingly to the forefront in recent months. The contribution of science to the war effort was the subject of comment by the Minister of Production in recent speeches, and Government provision for research was discussed in the House of Lords on July 15 and 20 (see NATURE, July 31, p. 129). On June 1, Sir Stafford Cripps made an important statement to the Parliamentary and Scientific Committee on "Future Requirements of Research and Technical Development in Great Britain and Supply of the Necessary Personnel", and that Committee has submitted a memorandum on scientific staffs to the Departmental Committee on the Training of Civil Servants. The Parliamentary and Scientific Committee has also prepared an important report on Coal Utilization Research and the National Economy, and a deputation from the Committee on this question was received by the Lord President of the Council on June 29. A research sub-committee of the Committee on Post-War Planning of the Institution of Electrical Engineers has issued a report on the organization of post-war electrical research, in which the formation of a British Electrical Research Board is proposed as an instrument to secure the maximum progress in the application of scientific research within the electrical industry in Great Britain.

Behind the details of any such concrete proposals there are broader issues which were touched upon, for example, in Sir Robert Watson-Watt's presidential address to the council of the Association of Scientific Workers in May, and in a letter from the chairman of the Joint Council of Professional Scientists and the presidents of the Royal Institute of Chemistry and of the Institute of Physics which has appeared in *The Times* and elsewhere. Sir Robert Watson-Watt pointed out that those who believe that a political scientist is a menace to science overlook the fundamental character of science. The fact that scientific workers are also citizens with responsibilities as members of the State which transcend their individual needs and interests means that they are bound to attempt to exert some influence on the public policy of the State. As scientific workers they are concerned with the accumulation and acceptance of ordered knowledge, but as citizens they are profoundly concerned with the application of this accepted knowledge for the general good of the State and of the world at large.

That position is not inconsistent with the warning which is sounded in the letter from the Joint Council of Professional Scientists mentioned above, and repeated in a subsequent interview by Sir Robert Pickard, against exaggerated expectations of rapid results. The time-lag in the application of research is one reason why it is important that immediate preparation should be made for reconstruction, and the necessity for planning a long way ahead is one of the reasons why planning is as important for the advance of science as of society. There is, in fact, as Sir Robert Watson-Watt remarked, no alternative to planning but the dream-world which he labelled "planned sporadicism".

The real question is the character, the objectives and the limits of planning. It should be a means to an end and not an end in itself; and the purpose or end which planning is to serve is the all-important criterion as to whether planning is good or bad. On this we may well note the denial in the letter from the Joint Council of Professional Scientists of the contention that the man of science is pre-eminently fitted for the position of leader in a democratic community. The weakness of that position, which is rarely claimed by responsible men of science, has been shown admirably by Prof. E. H. Barker. The man of science might well be consulted more frequently than he has been in the past, and we may well develop a more effective technique for utilizing his advice and services. When that advice has been given, however, the duty of the man of science, as such, is at an end; his claims to be considered an administrator or statesman must depend on his possession of knowledge and ability covering wider fields. The argument that scientific knowledge and ability are not inconsistent with the possession of administrative ability, and that they should not be allowed to debar the scientific worker as such from high administrative positions, must not be construed into an argument for the placing of scientific men or women in administrative positions on the ground of their scientific qualifications. That might, indeed, be a short cut to a soulless technocracy indistinguishable from despotism.

Fortunately, there is no reason to rate that danger as high. The emphasis laid in recent pronouncements on the education of scientific workers on the importance of a sound general education as a basis for specialization, like the emphasis now being laid on the necessity for any administrator to possess a broad appreciation of the nature of scientific method, the achievements and potentialities of research and of the structure and methods of scientific industry, is some assurance that mistakes of the past are on their way to being rectified. Effective planning, in science as elsewhere, presupposes a high standard of education in the broad as well as in the technical sense. No plans for post-war reconstruction are, in fact, more important than those which relate to education, whether of the administrator or of those whom he is to serve, and the success or failure of our efforts to build a better world and to achieve the four freedoms, like the security of our democratic institutions, ultimately depend on our ability to meet the searching demands which they make on us in character and in intelligence.

Remembering, therefore, that planning in science, as in a democracy, must be planning for freedom, and limited to those measures which will further the broad objectives desired by the community, we can proceed to consider the measures which may be required in particular fields. It is natural that our closer association with the U.S.S.R. should stimulate interest in Soviet achievements, which Mr. J. G. Crowther recently dealt with in the Trueman Wood lecture before the Royal Society of Arts, and on which Sir Stafford Cripp touched in his statement before the Parliamentar and Scientific Committee. Those achievements ar often compared with the research effort of Grea Britain, much to the disadvantage of the latter, an it may well be that Sir Stafford Cripps is right i holding that we have even yet not realized to the fu the place that research should take in developmen and production.

Admitting that the pre-war provision for researc in Great Britain compares unfavourably with tha of the United States or of Soviet Russia, it must no be supposed that the position can be rectified immediately by the allocation of financial and materia resources more commensurate with the effort required The supply of personnel alone, as Sir Stafford Cripp observed, is an obstacle to rapid expansion, and th difficulties in obtaining a sufficient number of researc workers at present experienced by the various Suppl Ministries are likely to be encountered in industr and elsewhere after the War. A shortage of thi kind can only be eliminated as a result of an appropriate educational policy. The research worker moreover, is only one member of the team of scientifi workers and technicians required; the skille technical personnel for the technical applications o scientific research and for the engineering an development work involved must also be available.

To increase the relatively small output of suitabl men and women from the universities and highe technical colleges is a matter of educational policy, and this is ultimately the responsibility of the State, which now provides directly or indirectly a very large measure of the finance and planning of educational facilities. As yet it has not been decided how we are to plan and manage the whole range of basic and applied research necessary to safeguard the future of our industries. What is required, Sir Stafford said, is to increase the volume of research, both basic and applied, and, at the same time, to introduce some measure of planning so as to make the best use of the available resources. We must also decide through what agencies we want this research to be carried out, and how much of our national wealth we are prepared to devote to the research itself, as well as to the provision of the personnel for research, technical development and production engineering.

Sir Stafford Cripps is clearly of the opinion that the need cannot be met entirely by private research institutions—they have not the resources available in national institutions—but he did not commit himself so far as the report of the Committee of the Institution of Electrical Engineers in condemning the competitive basis of industry as opposed to the re-organization of research on co-operative lines. The proposals for a British Electrical Research Board may be held to depend too much on a basic change in the character or structure of industry, the value of which is at least open to debate.

Sir Stafford Cripps himself looks rather to the establishment of further State institutions—he instanced the need for a first-class institution for aeronautical research—as the feature of a State research service. He also considers that we need a State scientific service, apart from, but on a parallel with, the administrative Civil Service. Such a service should be under the control of a single responsible Minister able to draw together all the threads of scientific effort so far as the State is concerned. The actual administration of the research should be under the control of a body of men of science : he suggested that the Royal Society, if provided with a special administrative staff for the purpose, might perform that function.

While he emphasized that these matters are primarily for scientific workers to determine, even if their decisions must take the form of advice, Sir Stafford regards such developments as a natural growth out of the present haphazard system. He suggested the introduction of a consolidating and enabling Bill to deal with the whole question, and to correlate it with the work of the universities and the industrial research institutions. He believes we must envisage spending after the War at least ten times as much as in 1938–39 if we are to make headway or even to keep abreast in such industries as the light chemical, optics, radio, civil aviation, as well as in the heavier industries.

In replying to a question from Prof. A. V. Hill regarding the means of raising the status of the scientific worker, the importance of which Sir Stafford Cripps had stressed, Sir Stafford suggested that this would be one consequence of establishing a Government scientific service and that the process would be further assisted by the expansion of our research effort. Prof. Hill also raised the question of the possibility of a superannuation scheme not only in universities and in some Government establishments, but also throughout the scientific services and industry. Sir Stafford Cripps agreed that some correlation in this field would be possible, but valuable as such a scheme would be as a stimulus to the interchange of personnel, it involves certain dangers to the individual initiative and independence of the scientific worker. The dangers of State control are elaborated by Prof. M. Polanyi in a recent paper on "The Autonomy of Science" (*Mem. Proc. Manchester Lit. and Phil. Soc.*, **85**, 19–38). Prof. Polanyi's admirable argument for the importance of the autonomy of science, however, will be as warmly welcomed by those who are urging the more rational use of our scientific resources as by those who attempt to argue that planning and science are incompatible.

Prof. Polanyi himself appears to confuse the broad planning and orientation of scientific effort to secure a steady advance along the whole front and the apportionment of scientific effort where fresh knowledge appears to be most required, with the interference with scientific results and the suppression and distortion of truth which we have witnessed in the totalitarian States. Scientific men can never give a guarantee of results. They cannot fit their discoveries to suit preconceived ideas or desires without disloyalty to the quest for truth which is of the essence of their calling. A research worker who deliberately concealed some fact in the field of vaccines, for example, because it was inconvenient or inconsistent with a Government policy of vaccination, is indeed disloyal to science and could no longer claim to be a scientific worker. He would not, however, be impairing that loyalty and his professional integrity if, as Prof. Polanyi appears to argue, in response to a request from the leaders of his profession, he laid aside for the time those investigations to undertake work in some other field, for which he was equally qualified, where a solution to some other problem was urgently required for the relief of suffering.

It is no argument against the planning of science that we cannot tell where the fundamental discoveries or the real advances will be made. That view has indeed been strongly challenged by Bavink, who argues that in the physical sciences it is possible to state within limits exactly where lie the problems still to be solved, though he does not claim that the applications of such fundamental discoveries are equally predictable. What is axiomatic is that we cannot escape the responsibility for prosecuting scientific effort, where according to our best judgment it is likely to be most fruitful. That judgment may prove to be mistaken, but if it is honestly made, based on a critical survey of the facts of the whole situation so far as they can be determined, we are at least not open to the charge of prostituting science or wasting scientific resources. We have made an attempt at something more than a guess at the direction of further progress, and the mistake itself can prove a stepping-stone for a further advance.

Scientific workers should not therefore be reproached for disloyalty to science when they accept a broad direction as to the fields in which they should work. Planning to that extent does not encroach on the essential freedom of the scientific worker, his creative powers and initiative, his professional integrity. Prof. Polanyi has described this position of the scientific worker and the indispensable autonomy of his creative life so admirably that it is, to say the least, unfortunate that he should impute to the type of planning and organization of scientific effort and resources urged by Sir Stafford Cripps an attempt to interfere with the internal discipline of science and the decisions leading to discovery. Sir Stafford Cripps, like every other serious advocate of the more effective organization of our scientific resources, makes it clear that while the community may, and should, claim the right to determine within broad limits the extent of the resources to be devoted to scientific and technical research, and the broad allocation of those resources between different fields and on major projects, that allocation must be subject to the advice of men of science themselves, and the technique and the manner in which the particular problems are attacked must be the affair of the scientific worker alone.

Planning for freedom in this manner accordingly involves a more efficient organization of the scientific community itself, the elaboration not merely of the machinery for exercising more effectively scientific discipline, particularly in those borderlands of the sciences where advance has so often been most fruitful, but also of the machinery for assisting the allocation of effort between the different fields and determining the major programmes of work. Moreover, there must be the proper organization of the scientific community in its relations with the society and nation of which it forms a part, so that scientific advice can be more effectively brought to bear on the problems of the nation and supplied in terms understood by administrators and the people at large. These considerations are all involved in the effective planning of science for freedom. The education of the man of science himself is only a part of the large task of education to be undertaken, and in addressing themselves to those problems of the more effective organization of our scientific resources on which Sir Stafford Cripps touched and the rapid expansion of our endowment of research, scientific workers must not overlook these important questions of the re-organization of their own community, so that their knowledge may be presented to the community and its leaders in the most effective channels and in the most lucid and widely understood manner.

SOURCES AND IDENTIFICATION OF TIMBERS

Timbers of the New World

By Samuel J. Record and Robert W. Hess. Pp. xv+640+58 plates+8 maps. (New Haven: Yale University Press, 1943.) 10.00 dollars.

THIS monumental work is packed with most valuable and up-to-date information. In Prof. Record's well-known scientific and methodical manner no stone has been left unturned, and no effort spared, to treat the vast subject with accuracy. Probably in no part of the world could one find authors so well equipped, at least as regards the timber, to handle this great task, for apart from their own wide knowledge, they have access to the unique collection of 40,600 wood samples at Yale University, which is probably the largest collection of wood specimens in the world. Moreover, for the past eighteen years Record has published a journal known as *Tropical Woods*, which has included information on this subject gathered from all quarters of the globe. In addition, the long list of well-known names under the heading of "Bibliography" displays an exhaustive range of research.

The book is the more welcome since it arrives at a moment when we are unexpectedly faced with an alarming depletion of our own reserves of forest, and many sources of supply have been cut off, some perhaps permanently, and others at least for a long period. Although "The New World", as the authors term it, has already provided a large and regular supply of timber for many years, it may very well be that it still contains a great remaining store—at least of hardwoods—in a world the history of which reveals one continual source of forest destruction—by war, by fire, and by the march of civilization—which in all ages has destroyed without replenishing a most necessary element for its prosperity.

The book contains detailed descriptions of each tree, its geographical situation, its timber and comparative durability, the purpose for which it can be used, and last but not least the multiplicity of names by which it is known in all the different countries. This multiplicity and duplication of names, in the Brazilian timbers alone, has caused complete confusion, one which might justly be compared with th difficulty which confronts the chameleon when place upon a Scottish tartan. Many of the common name are repeated for woods which are of entirely differen qualities, and indeed of different colour, but a named alike. Record's work will help to correct thes difficulties.

Mr. J. S. Gamble's brother—Colonel Gamble, wh spent a great number of years in Brazil—got togethe an exhaustive and well-chosen selection of the timber of that country, which collection came into m possession more than twenty years ago, and afforde a very useful basis for checking up those specimen which I already had, and introducing new kind not formerly available. The whole collection wa named according to the local names of the distric from which the specimens had been taken, and o this account the greatest difficulty in identificatio was experienced.

When it is realized that 1,100 genera are include in the book under notice, a faint impression of th Herculean effort can be obtained.

Those who are interested in the timbers from Sout America will have their task made easier, although the will still meet with some unexpected changes of name

It is not often that a first-class botanist has th opportunity of also becoming an experienced timbe expert. In this case, however, Record is a past master as botanist, forester, and in the intricat study of wood structure.

The association of the botanical relationship o trees and the wood which they produce is, of course extremely close, and the dual study is of the greates interest, but whether in a treatise on *timber*, or th *trees* which produce the timber, the subject shoul be carried into the realm of families of trees, migh be open to question. From the commercial, or craftsman's point of view, the family of the tree which ha produced the wood is of no importance; for example beech belongs to the family Quercineæ, which includes also the oaks and chestnuts, and Castanopsis the woods of which are entirely different. Again, t couple the botanical name with the common nam of the wood only adds confusion.

Of late in Great Britain the required conditions o some contracts have had added to the common nam of the timber the botanical name, as for exampl English ash, *Fraxinus excelsior*, whereas the tern "English" ash is fully sufficient. Many hones operators will not sign the conditions of such contracts, as they contend that they do not know th botanical side, but the qualification 'English' alon would be sufficient to ensure a correct delivery. In a demand for teak the additional name is superfluous, the name Burma or Indian teak being sufficient, as there is only one species available. Again th botanical term is unnecessary, but when we come t supplies of mahogany the case is different. Th authors state "*Swietenia* [is] the source of the onl and true mahogany", which pronouncement may b correct, but also may not. A very controversial subject is opened if it is proposed in any individua endeavour to confine the supplies of mahogany t Swietenia sp. For more than three hundred year mahogany-like woods have been passed as mahogany and the resulting confusion, while it has had littl notice throughout the United Kingdom, has caused much dispute and litigation in the United States The subject is one on which a great deal might be said, but it is sufficient for the present review t direct attention only to the difficulties which are encountered if botanical terms and families of trees are to become an integral question in relation to timber.

These remarks, in any event, although suggested by the book, do not in any sense affect its usefulness, as the method adopted enables the reader to make easy reference. The whole work is supplemented by an excellent index, covering no fewer than fifty-two pages—by itself a remarkable achievement, which must have required great diligence and patience.

There are thirty-six well-chosen illustrations, of unusual interest, and twenty-two pages of photomicrographs, as well as exhaustive "Lists of families classified with reference to special properties and uses of their bark, leaves and timber".

In addition, the book contains illustrated maps, whereon are noted the areas whence the various woods are obtainable, with particular reference to those to which individual species are limited; information, both for the present and the future, of inestimable value.

This book, without which no arboricultural library would be complete, embraces all the interests of forestry and timber, and provides a fund of information never before available, surpassing those valuable contributions on this subject which we already possessed, and even the work which Prcf. Record himself and his associates have formerly completed.

ALEXANDER L. HOWARD.

PLACE-NAMES OF CAMBRIDGESHIRE

The Place-Names of Cambridgeshire and the Isle of Ely

By P. H. Reaney. (English Place-Name Society, Vol. 19.) Pp. lxi+396. (Cambridge: At the University Press, 1943.) 23*s*. 6*d*. net.

A LOT of water has flowed even under the bridges of the Cam since Prof. Skeat published his monumental work on the place-names of Cambridgeshire, and much new information, archæological and otherwise, has accumulated since that date. It has been shown that the area was peopled by Anglo-Saxon folk from a very early date—before the end of the fifth century—and the researches of such investigators as Sir Cyril Fox, T. C. Lethbridge and others have thrown a flood of light on these early migrants, their origins, movements and modes of life. The place-names of the county, in spite of the absence of *ingo's* endings, confirm the existence of these early settlements. The occurrence of personal names, ancient and rare words and primitive forms of compound make this clear. Celtic influence, on the contrary, seems to have been slight, so far as the place-names are concerned, though the river-name *Grante* and some other stream names do appear in some compounds. Scandinavian influence, though not strong, is noticeable, though only two villages—Toft and Bourn—are of pure Scandinavian origin. Again, Anglo-Norman influence was also apparently not strong.

The author will scarcely expect his work to be used as armchair reading; yet the fact is that anyone who knows the county finds himself looking up the name of village after village for the interest of what he will learn. It is dreadful to find by how narrow a margin Grantchester—which should be spelt Granteseta, meaning the settlers on the Granta—escaped being Grandchester, a horrid hybrid meaning the big Roman camp! Westley Waterless actually means water clearings to the west (of Dullingham); waterless being a corruption of waterlees or water meadows.

After an all too short introduction and some necessary fore pages, an account is given of the river-names, followed by those of the famous dykes. There then comes an account of Cambridge and its immediate environs, including the origin of the names of many of the streets. The rest of the book is devoted to the villages of the county arranged by hundreds, brief mention being given in each case of some names in the parish of fields, woods, houses, etc., which are of interest from an etymological point of view. These references, in the nature of the case, cannot be complete; space would not permit, and many people with local knowledge will necessarily look in vain for the origin of some familiar but not understood field-name. An index and three maps in a folder complete the volume.

This is certainly a work to possess, and the author is to be congratulated on its production. A small point struck me as interesting. How many inhabitants of the south-west part of the county remember that the villages of Great and Little Chishall and Heydon were transferred to Cambridgeshire from Essex so late as 1895? I can only testify that to-day the emotions of Heydon are strongly Cambridgeshire-wards, with indeed some slight antipathy to Elmdon, the nearest place in their former county of Essex!

M. C. BURKITT.

X-RAYS IN INDUSTRY

X-Rays in Research and Industry

By Dr. H. Hirst. Pp. 96. (Melbourne: Tait Publishing Co. Pty., Ltd., 1942.) Cloth, 7*s*. 6*d*.; paper, 5*s*.

IT seems to be the fate of the physicist to provide the tools for others to finish off the job. X-ray physics has provided a very practical tool for studying the inner structure of materials. Inevitably it has become the concern of the chemist, metallurgist and engineer. This, however, is a good omen, and for further effective application of X-ray work one looks forward to increasing contributions from people interested in the structure of materials from points of view other than that of the pure physicist. This book by Dr. Hirst, who surveys the field for the metallurgist, is a welcome sign.

Dr. Hirst considers both X-ray diffraction and X-ray radiography, and sets himself two tasks: to point out the type of application in which the X-rays might profitably be employed; and to give such guidance in technique that the metallurgist might hope to tackle the X-ray work himself. He has achieved both aims admirably, and made a useful contribution to a literature which has not catered greatly for the practical worker. His presentation is brief, but to the point.

In X-ray diffraction, the author has chosen the applications to study of alloy systems and stages in precipitation, chemical testing, temperature effects, grain size, and the structural changes accompanying plastic deformation. These applications are well known and have been described before, but scarcely with such emphasis on practical procedures. This makes the book useful to the newcomer, who is given tangible directions to go on, and interesting to the older hand who can compare notes and occasionally criticize. One criticism which might be allowed is that the working metallurgist will not wish to be limited to a circular camera technique which involves the reduction of his specimens to the form of filings or powders. He would soon require an arrangement to take normal whole specimens, preferably permitting of metallographic as well as X-ray examination. One also misses reference to the X-ray methods for measuring internal strains, which are finding extensive application, for example, in the examination of welds and problems of stress relief. In his treatment of radiography, Dr. Hirst has again emphasized the practical side. Industrial radiography has grown rapidly since the War began, and now consumes photographic film at a rate which would surprise the cinema industry. The standard is not uniformly high, and the practical points made by the author are not out of place. A clean radiograph, especially of an awkwardly shaped component in heavy metal, is often simpler in theory than in practice, and in this connexion, perhaps more reference would have been made to the use of filters in the primary beam, and to devices other than the use of lead paste to ensure the vital screening from unwanted radiation.

Whether the treatment of the principles and practice of X-ray diffraction is sufficiently comprehensive, as Dr. Hirst suggests, will depend on the work with which the practitioner is likely to be most concerned. In many fields it will certainly suffice for anyone to make a confident beginning, in which he will be aided by the initiative of certain manufacturers in putting reliable X-ray equipment on the market. Experience has shown that various types of work can be reduced almost to routine and undertaken by personnel without highly specialized training. On the other hand, there will always be investigations calling for considerable experience and versatility in interpreting and adapting the X-ray work. There will also be firms who may wish to use the method occasionally but not so often as to justify the expenditure on equipment and staff. Then there is a real case for the work to be undertaken by a central organization. To some extent this has been met in Great Britain by the facilities provided by the Department of Scientific and Industrial Research and by university laboratories. But the problem would repay systematic study, for the issues involved are not peculiar to X-ray work, and are likely to be encountered more frequently with the increasing complexity of scientific development and the growth of specialized techniques.

W. A. WOOD.

MAP PROJECTION

An Introduction to the Study of Map Projection

By Dr. James Mainwaring. Pp. viii+114. (London: Macmillan and Co., Ltd., 1942.) 5*s*.

IT is a common complaint that examination syllabuses exert an undue influence on the school curriculum; but it is a chastening reflexion that, in the case of map projections, the regulations of examinations boards have, to a considerable extent, saved a valuable subject from unmerited oblivion, though not from neglect. One of the worst reasons for the study of a subject in schools is that "questions are set on it", because it produces an attitude which leads to cramming.

The fact is that we have not hitherto evaluated the subject as an educational instrument, and there is now a danger that utility in the limited sense may receive too great prominence; those who feel most strongly would stress rather its educational value.

What we teach in the subject will be conditioned by our reasons for teaching it; the kind of textbook required will emerge from these decisions. It is clear that books written to meet the needs of the cartographer are only suitable in schools for purposes of reference. The school should aim at giving a sound grasp of principles to as many pupils as possible and, in any event, as those specializing in geography may be on the arts side, we must regard the basic mathematical equipment as of school certificate standard only.

Dr. Mainwaring has made a noteworthy contribution to the teaching of the subject: his book, ostensibly written as an introduction to map projections, aims at Higher School Certificate standard; actually he presents to us a well-considered scheme admirable in plan and execution, likely to develop interest and to provide a suitable foundation for more advanced work.

He writes under headings: (*a*) the problem; (*b* the process; (*c*) the application. The first deals with the relevant properties of the sphere, explains such terms as great circle, loxodrome and orthomorphic, and leads up to the aim of map projections. The explanations are accompanied by effective diagrams, the most striking showing great circle and west to east routes from Madrid to Peiping on Mercator and gnomonic nets; the section ends with six different nets between longitudes 0° and 15°.

Describing processes, projections are classified and dealt with as cylindrical, conical, zenithal, modified and arbitrary. Again the method is comparative and in each case a formula is obtained. In this connexion, it may be noted that the equation for the position of Molleweide parallels is proved but does not provide a ready means of solving the problem; may I suggest that a graphical solution has educational advantages over the use of the table? In the case of Mercator, it is suggested that the distance of a parallel represented by $R\int\sec\theta d\theta$ may be found by performing the summation $\Sigma_1^n\sec(x-\frac{1}{2})^\circ$, where n is integral, using the 30′ column in four-figure tables of secants. Up to 80° this gives 139·56 equivalent equatorial longitude degrees, that is, 2·436 R.

The third section considers the choice of projection in relation to its use; it begins with a useful summary of the properties of those studied and is illustrated by well-chosen diagrams. The world is shown on four maps the uses of which are critically examined; two other world maps illustrate the advantage of interrupted projection. Africa and South America are exhibited on four nets with the same equatorial scale. North America is used to compare Bonne's and Lambert's, while the U.S.S.R. illustrates the use of two standard parallels.

It is to be hoped that those who adopt the book will spread the work over the two-year geography course; the contents will be best absorbed gradually, if their full implications are to be appreciated. Perhaps also the mathematical staff would like to make use of the book.

As a final note, there are still worlds to conquer in the field of useful projections; to encourage such research we cannot have too many interested students.

The author is to be congratulated on producing a book so uniformly good in text, diagrams and questions; the publishers, too, have done justice to it.

A. HINCKLEY.

An Atlas of Stellar Spectra

With an Outline of Spectral Classification. By W. W. Morgan, Philip C. Keenan and Edith Kellman. (Astrophysical Monographs, sponsored by the *Astrophysical Journal.*) Pp. vi+36+55 plates. (Chicago: University of Chicago Press; London: Cambridge University Press, 1943.) Price 60*s.* net.

THIS much-needed atlas defines a two-dimensional classification system of stellar spectra by means of a sequence of standard spectra, many of which are illustrated in the fifty-five photographic prints forming the main body of the work. The spectra were taken specially for the purpose on a small one-prism spectrograph attached to the 40-in. Yerkes refractor. The standard stars chosen, which are mostly brighter than the eighth apparent magnitude, are of types from *O*5 to *M*2, and were selected to exhibit a large range of luminosities. A given spectrum is considered uniquely classified when its spectral type (one of the conventional seven classes subdivided decimally) and its luminosity (one of five classes ranging from supergiants to the main sequence) are specified.

The "Outline" accompanying the prints gives a brief review of the taxonomic principles involved, and goes on to describe the criteria employed for both co-ordinates of the classification, and to tabulate the standard stars. No originality is claimed either for the system defined or for the criteria used: of necessity they are both evolved from work done, mainly at Harvard and Mount Wilson, by many previous investigators. The spectral types are closely correlated with colour, and will thus be invaluable in studies of interstellar absorption. The luminosities, when calibrated, will make possible the determination of accurate spectroscopic parallaxes on low-dispersion spectrograms.

The prints themselves are excellently reproduced and show well the lines, often quite faint, which are used for the classification of spectral type or luminosity. They are negative prints and can thus be compared directly with spectrograms in the observatory. The descriptions, though concise and lucid, are reproduced in a manual script which does not enhance the appearance of the Atlas, but the "Outline" is printed in the impeccable tradition of the "Astrophysical Moncgraphs". It is not too much to predict that this work will quickly become a tool indispensable to every practical astrophysicist.

The Earth and Man

A Human Geography. By Prof. Darrell Haug Davis. Pp. xxiii+675. (New York: The Macmillan Company, 1942.) 21*s.* net.

AS geographers become more agreed on their province of study, they approach nearer to what might well be termed human ecology and find a field of observation that has been largely neglected in other studies. The analytical outlook, in geography as in other sciences that deal with living organisms, gives place to the more difficult synthetic outlook, which in geography is one of great complexity, because man is more concerned in improving, or at least in changing, his environment than in being dominated by it. In human ecology, the organism's reaction is far greater than in plant and animal ecology, and the risk of neglecting human influence on surroundings is a constant danger.

Prof. Davis has written a careful, though not profound, introduction to this aspect of geography, but he claims no further aim than the writing of a text-book for the early stages of university work, and this no doubt explains his general avoidance of problems in social geography. He has produced an admirable survey of the factors that decide the grouping and pattern of human distributions with special reference to North America. The rest of the world—especially the monsoon lands of Asia—are not neglected, but the book is primarily for American students. It is admirably illustrated with maps, diagrams and photographs, and has a full index. The bibliographical references might well be on a wider scale. R. N. R. B.

The Bushman Tribes of Southern Africa

By A. M. Duggan-Cronin; with an Introductory Article on the Bushman Tribes and Descriptive Notes on the Plates, by D. F. Bleek. Pp. v+15+40 plates. (Kimberley: Alexander McGregor Memorial Museum, 1942.)

ALTHOUGH the actual text of this book comprises only 14 pages, a great deal of reliable and interesting information is given on the physical characters and culture of the Bushman tribes. This information is supplemented by a useful map showing the distribution of the various tribal units. It would, perhaps, have been a useful addition to have provided a short key to the rather baffling system of phonetics employed in writing native words. Condensation was naturally necessary in so brief an introduction, but this brevity is in certain cases rather unsatisfactory. It is tantalizing to be told that: "In all tribes they make rain in some manner", but to be given no hint as to the procedure adopted in any tribe.

The story of these people is a sad one: "They are being gradually forced into servitude of black or white men, and absorbed into the coloured population of South Africa". The forty plates, most admirably reproduced from excellent photographs, constitute a permanent and valuable record of these doomed people. In them are preserved scenes from their daily life, records of many of their social and cultural activities and the physical characters of certain well-selected types. The National Research Board of South Africa and the authorities of the Alexander McGregor Memorial Museum are to be congratulated on the production of a publication of such perfection in the year 1942. F. WOOD JONES.

The Cathode Ray Oscillograph in Industry

By Dr. W. Wilson. Pp. xii+150+42 plates. (London: Chapman and Hall, Ltd., 1943.) 12*s.* 6*d.* net.

APPLICATIONS of the sealed-off cathode-ray tube to the field of radio have been previously well treated, so the author gains by concentrating on other applications, which are shown to be wide and valuable. Controlling electron beams in cathode-ray tubes, electron diffraction tubes, and electron microscopes exhibits many common features, and the author brings these and related topics up to date in book-form. He also shows that the sealed-off glass tubes and the metal continuously evacuated tubes have their separate fields of application and are not always competitors. He gives some of the latest electron microscope photographs, and shows how essential this new instrument is in many fields of research. It is unfortunate that the War has further retarded the development of electron microscopes in Great Britain, an opportunity which even private generosity has neglected. The text is well produced considering the present conditions, and includes the essential references. L. E. C. HUGHES.

ARTIFICIAL PRODUCTION OF DIAMONDS

By DR. C. H. DESCH, F.R.S.

THE claim of Moissan to have produced diamonds by the rapid quenching of molten iron or silver containing carbon in solution, causing solidification to take place in the interior of the mass under high pressure[1], was widely although not universally accepted, and found its way into the text-books. Le Chatelier, himself a very careful experimenter, was sceptical of the identification[2]. The later work by Sir Charles Parsons[3] tended to show that pressure alone was not responsible for the separation of carbon in the form of diamond, but that the entrapped gases played an essential part. In all these experiments the crystals obtained were very small, and were chiefly identified by their hardness, high refractive index, density and single refraction. It does not seem that Moissan's crystals were ever subjected to tests by any other worker, although Sir William Crookes[4] satisfied himself that small true diamonds had been produced. Moissan's own statements are categorical. Quantities of a few milligrams of black crystals prepared from silver and of transparent crystals from cast iron were burnt in oxygen, and after deducting the unburnt ash the weight of carbon dioxide obtained corresponded almost theoretically with the combustion of elemental carbon. The crystals had the correct density of 3·5.

Parsons used other methods. Besides repeating the experiments of earlier workers, with negative results, he produced instantaneous high pressures by means of explosives and by firing high-velocity rifle bullets into cavities containing the materials to be compressed. Experiments were also made in a 2,000-ton hydraulic press with electrical heating, producing only graphite. Some of the experiments with gases gave crystals which were apparently diamonds. On attempting to carry the process further, Parsons felt some doubts as to the identity of the crystals which he had formerly obtained, it being easy to mistake spinels (which are octahedral and optically isotropic, and in general appearance resemble diamonds, and are also highly resistant to the chemical agents used to dissolve mineral matter) for diamonds. It is true that on heating some of the crystals in a stream of oxygen flashes had been seen, indicating combustion, but it was found that in the long series of operations needed for the isolation of the crystals, particles of dust were liable to enter, and that it was these which were burning. Parsons, repeating his experiments with meticulous care, with the assistance of Mr. H. M. Duncan, found that his own crystals remained unburnt. The two investigators also repeated the experiments of Moissan and of others who had claimed to have produced diamonds, but again with negative results. Inquiries in France failed to locate any of Moissan's original crystals. Sir Charles Parsons, with the scrupulousness which was characteristic of him, submitted the whole of the evidence, including his own note-books and much correspondence with friends of Moissan, to the editor of NATURE, at whose suggestion the writer prepared a summary[5] leading to the conclusion that there was no satisfactory proof that diamonds had ever been obtained by any artificial process.

An earlier and less famous investigator who claimed to have produced artificial diamonds was James Bannatyne Hannay. In 1939, Prof. W. M. Travers[6] gave some account of the career of Hannay, a most ingenious and persevering experimenter, who as a boy was attracted by chemistry, and without any college training, becoming an assistant in the laboratory of a Glasgow chemical works, soon published a series of papers on improved analytical methods. Sir William Ramsay was a friend of his boyhood, and discussions between the two must have done much to stimulate Hannay's interest in research. He became works manager, but retired in 1876 on account of ill-health, and two years later became an assistant lecturer in Owens College, Manchester; actually he worked there only for two months, the reason being again bad health. He then took up private technical work, presumably as a consultant, and to this later period belong his most important investigations. He was particularly interested in high pressures and in the properties of substances at the critical temperature, on which he contributed papers to the Royal Society.

Hannay's work on diamonds[7] arose from his studies of the power of gases, especially water vapour, to dissolve solids under very high pressures, and he thought that if carbon could be brought into solution in some gas under high pressure, it might crystallize as diamond on cooling. In his first experiments he heated hydrocarbons with lithium in sealed glass tubes, the object being to bring about thermal dissociation of the hydrocarbon, absorbing the hydrogen produced in the alkali metal. Crystals which would scratch glass were occasionally obtained, and as these were octahedral, optically isotropic, showed the characteristic curvature of the faces, resisted hydrofluoric acid, and burnt in oxygen, he concluded that they were true diamonds. However, he thought it advisable to use higher temperatures and pressures than could be reached in glass tubes, and a change was made to tubes of wrought iron. The tubes were 20 in. long and ½ in. bore, but the thickness of the walls, at first only ¼ in., had to be progressively increased to more than 1½ in., on account of bursting. Various plugs were tried but invariably leaked. It was found necessary to close the open end by a blacksmith's weld, the modern methods of welding not having been invented, and as this had to be done on a short length of tube two thirds filled with volatile liquid, it is not surprising to read that "It requires great skill on the part of the workman, and it is only one man in a hundred who can perform the operation with invariable success". The sealed tubes were heated in a coal-fired reverberatory furnace. All but a few of the tubes burst during heating to redness; and as on many occasions the furnace was wrecked and had to be rebuilt, Hannay's perseverance must be considered as extraordinary. Out of more than eighty experiments only three were successful. Tubes bored from solid steel bars failed badly.

Hannay had been seeking commercial uses for 'bone oil', a mixture of nitrogenous compounds obtained by distillation from bones, and this occurred to him as a possible solvent for the experiments on diamond. Its volatility (the fraction boiling between 115° and 150° was used) made welding still more difficult, while "the continued strain on the nerves, watching the temperature of the furnace, and in a state of tension in case of an explosion, induces a nervous state which is extremely weakening, and when the explosion occurs it sometimes shakes one so severely that sickness supervenes". In spite of these difficulties, Hannay obtained some positive results, using a mixture of 90 per cent of "paraffin spirit" and 10 per cent of bone oil with the addition of solid lithium. The hard residue was crushed, and was found to contain some transparent crystals which were identified as diamond. A combustion carried out on 14 mgm. gave 97·85 per cent of carbon.

In spite of the small number of successes, it is difficult to believe that Hannay was mistaken in his identification. As his solid residues contained nitrogen, he was inclined to believe that the diamonds owed their origin to the nitrogenous compounds used and not to the hydrocarbons, a point which would have an important bearing on the origin of the natural crystals. Although he announced his intention of making further experiments, no later paper on this subject appeared, although he published work on other subjects so late as 1894.

Moissan attempted to repeat Hannay's experiments, but could not succeed in welding the tubes. Parsons also tried the same materials and pressures, but without success, and the work might have been forgotten but for the fortunate fact that twelve of the minute crystals obtained by Hannay in 1879–80 had been deposited in the mineral collection of the British Museum (Natural History). None of the crystals obtained by either Moissan or Parsons has been traced.

The whole subject has been transformed by recent work with X-rays. Mrs. K. Lonsdale and Mr. F. A. Bannister[8] were able to examine by X-ray methods the crystals preserved at South Kensington, and found some of them to be true diamonds. What, however, was still more remarkable was that they showed the characteristics of the rare (type II) diamond described by Sir Robert Robertson and his colleagues[9], which differ profoundly in optical and electrical properties from the normal type I. One was definitely identified by its X-ray pattern as of type II, while the others showed the highly laminated condition which is associated with that type. Since type II only occurs in about one per cent of natural diamonds, the probability that Hannay's crystals were actually obtained artificially is greatly strengthened, and the accuracy of his statements vindicated. It is clear that the new observations re-open the whole question, and that, in spite of the failure of Parsons and Duncan to convince themselves that they had obtained true diamonds, and their consequent rejection of earlier work, it may prove that the methods of high pressure and high temperature common to the work of Hannay, Moissan and Parsons do actually succeed in converting a minute proportion of the carbon contained in the materials into diamond, although the factors determining such a transformation remain very obscure, while the fact has to be borne in mind that all diamonds, exposed to a sufficiently high temperature, are changed to graphite. A very old problem thus comes again into prominence, but with the advantage of experimental methods of rapid identification which were not available to the earlier workers.

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[1] Papers in *C.R. Acad. Sci.* from 1894 onwards. Summarized in "Le Four électrique"; English translation, "The Electric Furnace" (Easton, Pa., 1920).

[2] Le Chatelier, H., "Leçons sur le carbone" (Paris, 1926), p. 24.

[3] Parsons, C. A., *Proc. Roy. Soc.*, A, **79**, 532 (1907); *J. Inst. Metals*, **20**, 5 (1918); *Phil. Trans.*, A, **220**, 67 (1920).

[4] Crookes, W., "Diamonds" (London, 1909).

[5] NATURE, **121**, 799 (1928).

[6] Travers, M. W., *Chem. and Ind.*, **17**, 507 (1939).

[7] Hannay, J. B., *Proc. Roy. Soc.*, **30**, 188, 450 (1880).

[8] Bannister, F. A., and Lonsdale, K., NATURE, **151**, 334 (1943).

[9] Robertson, R., Fox, J. J., and Martin, A. E., *Phil. Trans.*, A, **232**, 460 (1934).

NATURE AND USES OF SEAWEEDS*

By R. E. MARION DELF

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IN the last fifty years or so there has been much progress in our knowledge of seaweeds, but until comparatively recently, mainly from the botanical point of view. Until this century, botanists had been chiefly concerned with nomenclature and with the major facts of structure and reproduction of a few commoner types. But early in this century, newer lines of investigation were being developed, involving the systematic analysis of vegetational units and the study of the complex relations between the plant and its environment. Mr. A. D. Cotton has made an ecological survey of the marine algæ of Clare Island, off the coast of Ireland. This study, the first of its kind by a British author relating to the algæ, became and has remained a classic for other workers in this field.

Another and rather different line of advance during the last thirty to forty years has been in the study of the life-histories of the marine algæ, stimulated in Great Britain by the work of Lloyd Williams (1906) and in France by that of Sauvageau (1915). Lloyd Williams found that in the brown alga *Dictyota dichotoma*, Lamour, two generations, externally similar, followed one another, each devoted to a different kind of reproduction, one with sexual, the other with asexual reproduction. He also found a definite rhythm of reproduction, closely related to tidal phenomena. Sauvageau made the even more striking discovery that the innumerable swimming spores produced by the different species of Laminaria (reckoned by Yendo as about 84,000 per square millimetre) could be made to germinate, when they developed into minute branched threads requiring high magnification for observation. These ultimately gave rise to gametes, which after fertilization reproduced the early stages of the original type of plant.

The effect of this discovery on the botanical world was far-reaching. It has been found that this type of alternation is characteristic of the whole family of Laminarias, though by no means limited to it. In many apparently annual types, like the familiar 'sea bootlaces' (*Chorda filum*, Lamour), although the visible thallus or 'bootlace' dies down at the end of the summer, a microscopic sexual generation is produced and carries on the cycle unseen beneath the waters during the winter months.

In respect of the red algæ, Yamanouchi followed the still more complicated life-history of *Polysiphonia violacea*, Harv. (1906), and this became the forerunner of many similar investigations, notably those of Svedelius (of Copenhagen) and of Kylin (of Bergen). Although most red algæ have alternation between two similar plants, it is beginning to be realized that others have great difference in form between their alternate generations, even when both are equally visible to the naked eye. To establish their identity is then no easy matter, for most marine algæ are difficult to cultivate under artificial conditions. It is not surprising that nomenclature of the marine algæ is in a backward state, since in the past it has been founded largely on the observation of material (often dried) apart from a knowledge of life-cycles,

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[*] Substance of a paper read before the Royal Society of Arts on May 12.

or of other differences in form brought about by the influence of a particular environment. There is, as yet, no systematic record of the algal vegetation of our coasts. Such accounts as are available relate to particular localities, usually to summer resorts where rocks are relatively accessible, or to regions within the sphere of influence of marine biological stations, like that at Plymouth or at Port Erin, in the Isle of Man. Little is known of the interaction between the animal and plant population of the shore.

Whereas some seaweeds are permanently submerged in pools or in deep water, the majority are amphibious, in that they spend part of their lives under water, part exposed to the air, owing to the receding of the tide. Unlike some amphibious animals, they are fixed to some substrate, so that they must endure, at least temporarily, all atmospheric vicissitudes. They may be heated by the sun, cooled by wind or frost and dried by the action of wind and sun together. The sea-water adhering to them may be diluted by rain or concentrated to brine by evaporation. The time of exposure varies with the height of the tide and the position on the shore. Those near the upper limits have longer exposure, and unless they are to be found in fairly deep pools, only species which are resistant to desiccation can survive in this region. For the same reason, in hot climates, intertidal vegetation is much more sparse than on temperate shores. The middle regions of the shore are the most densely populated by both animals and plants, and here competition for space and light is the keenest; while at the lower limits, the depth of water is such that there is too little light for any but shade plants (mostly red algæ) or brown ones like the Laminarias with long stipes which bring the flat fronds up towards the surface.

On the whole, in temperate climates there is a marked tendency towards zonation—at low water, the higher and middle regions of rock or shore being predominantly brown, from the more numerous of brown algæ, the lower regions red or brownish-red. The underlying causes of this zonal distribution has of recent years been the subject of much discussion.

All this is not merely of general or academic interest. If, as seems not unlikely, seaweeds may become an asset of some commercial importance, conditions of their growth, regeneration and harvesting must be more fully explored. In suitable localities and on suitable shores it may then be worth while to cultivate the more profitable kinds. Something of the kind is, indeed, already being attempted on a small scale in the so-called Fucus farms of Northern Ireland, where the harvest is utilized locally for manuring the fields. These farms are located in somewhat sheltered bays where, at low water, there is a flat stretch of sand strewn with large stones, boulders or rocks. The kind of alga which develops depends partly on the nature of the anchorage, partly on the position with respect to tidal range. Thus the boulders and larger stones of the upper middle tidal zone become covered with Ascophyllum; the smaller stones wedged between bear *Fucus vesiculosus* L., the common bladder wrack; while at lower levels both stones and rocks bear *F. serratus* L.

These three species form the bulk of the harvest, and when cut are regenerated from sporelings; but apparently two or three years must elapse between successive harvests from the same area, and no attempts have been made, so far as I know, to improve the yield or to shorten the period of regeneration and maturation; more stones are sometimes added, however, and this demands a certain amount of judgment as to size and suitability. At the present time, a number of research workers at Port Erin are engaged in studying the growth-rate and reproduction of certain seaweeds of possible future importance with a view to their more rational harvesting, and it is to be hoped that these and other investigations will be continued and expanded in post-war years.

Seaweeds have been used extensively in the East for many years; in Japan especially for food, manure and glue. Early in this century, when commercial developments were visualized, a definite cultivation was inaugurated there. For this purpose, suitable rock-surfaces were cleared of weed during the period of reproduction. After a time, the water being full of their spores, a new crop appeared, which successfully established itself in spite of competition with other kinds which usually arrived first.

The Japanese botanist Yendo was instructed to study and report on the conditions for success and also on the causes of failure in certain areas. With the help of this report and the practical experience of fishermen who were employed in the cultivation, instructions were drawn up and circulated as to planting and harvesting the appropriate seaweeds. On certain reefs, constantly removing crops of Laminaria favoured the spread of a useless plant, Phyllospadix (one of the few submarine flowering plants), which covered the surface with its undergrowth and smothered the young plants of Laminaria. The removal of the Phyllospadix was therefore made compulsory, a special tool being designed to facilitate the periodic weeding.

Yendo pointed out that seaweeds, like other plants, had their peculiarities which must be considered: for example, Gloiopeltis, from which much glue is made, flourishes best on smooth, hard surfaces, in positions where there is spray or foam; on the other hand, rough surfaces suit most seaweeds, Laminarias requiring a hard rock, like quartzite, pitted with numerous depressions. Porphyra is grown by planting small twigs obliquely in crevices in areas where the salinity is high. This gives the greatest number of sporelings: the twigs are then transplanted to places where the salinity is lower, in order that the finest fronds should develop from the sporelings.

Not all marine plants are seaweeds in the stricter sense of the word. Zostera, the eel-grass, for example, which occurs in relatively quiet waters, is a flowering plant, producing flowers and fruits beneath the waves. The true seaweeds, on the other hand, are plants of a much lower order in the evolutionary scale of plant life, as will have been realized in connexion with the life-cycles to which reference has already been made.

The great differences between the marine algæ and the flowering plants are seen, however, in many other features—for example, in their general organization, the plant having no root system, no buds or flowers, and, of course, no seed production. It is also seen in their construction, which has little in common with that of flowering plants even when these, like Zostera, have the same habitat.

The building of a structure may be said to depend on three things—on materials, the building unit and on design. The building materials of the seaweeds are various mucilaginous and gelifying substances, cellulose playing little or no part in the composition of their walls. The unit of construction is the branched thread or filament, that is, a chain of cells rather than single cells aggregated into tissues. The whole structure is fabricated of variously interwoven threads, some of which may have walls of considerable thickness. Some of the threads send out lateral branches, the tips of which become compacted together, giving a firm exterior to the plant. In many surf plants, the threads become intricately intertwined, as the thallus is tossed about by wave action. Mucilaginous substances, believed to be derived from the cell walls, cement the whole together. The architecture of most seaweeds is such as to give flexibility with either elasticity and extensibility as in Ascophyllum and Himanthalia, or with a certain tensile resistance as in Fucus. The peculiar wall material also serves another purpose, readily absorbing water and retaining it with tenacity when exposed to drying. It is these wall substances which promise to become of great commercial importance.

The biochemical features of algal products have been explored from several angles—their pigmentation, their metabolic products and their wall substances differing considerably in the three great groups. Most of this lies beyond the scope of the present paper; but I should like to note in passing the success of a plant biochemist, Dr. Paul Haas (1931), in capturing and identifying the source of the characteristic smell of one of the common red seaweeds, *Polysiphonia lanosa*, parasitic on the brown alga *Ascophyllum nodosum*. The fresh alga was placed in a flask, kept at 30° C. by means of a water bath. Air was drawn through and carried over a volatile substance, which dissolved in water, alcohol or acetone. Afterwards this was found to be identical with methyl sulphide.

Utilization of Seaweeds

Generally speaking, seaweeds are utilized in three principal ways: in connexion with agriculture, as food or medicine, and for industrial purposes.

1. *Seaweeds in agriculture*. In agriculture, seaweeds are used as fodder or as manure. The seaweed may be fed fresh (sheep, for example, are allowed to graze on the rocks at low water in the Orkneys). In the north of Scotland, Pelvetia is brought to the boil and after addition of oatmeal is used to feed calves. Dried seaweed, ground to a meal, is used in some districts or, alternatively, the fresh seaweed is stored in layers with hay between, forming a kind of silage as winter feed. *Laminaria saccharina* was fed to horses with varying success in France during the War of 1914–1918. Reports of the results are not always in accord, perhaps because of seasonal variations in the food value of the alga, since the sugar content is at a maximum in the autumn and it seems that the sugar (stored as laminarin) is probably the most easily digested of the constituents. In New Zealand, seaweed (Macrocystis, Hormosira) is found to benefit cattle grazing on poor pasture land. In America, seaweed meal has improved health and fertility in cattle and in chickens, when fed as a small proportion of the daily diet.

The use of algæ as manure in maritime situations is widely practised. It is well known on coasts of Brittany, on various coasts of Ireland, in the north and west of Scotland and on coasts of northern Europe. Naturally, driftweed is largely collected for the purpose, but harvesting the cut seaweed is also practised where the coast is suitable. In north-west France the collection of algæ has been regulated by statute for some hundreds of years. The manurial value is probably due to the organic constituents, which provide bulk for the soil, as well as for the mineral salts. There is little nitrogenous value in most seaweeds, but the different kinds of laver (Ulva and Porphyra) are said to be exceptional in this respect.

2. *Seaweeds as food or medicine*. The use of seaweeds for food has been known from very early times. They are greatly valued in the East—in Japan, coasts of China and Malay; but they are also used on the north and north-west coasts of Europe.

Laver (*Ulva latissima* and *Porphyra laciniata*), dulse (*Rhodymenia palmata*) and murlins (*Alaria esculenta*) are eaten as vegetable on the coasts of Ireland and Scotland and no doubt elsewhere, and may be familiar in this capacity to a number of people. The name of sea lettuce for *Ulva latissima* is suggestive.

Pink laver is produced commercially in Japan, and the washed, pressed fronds are regarded as a delicacy. It is used under the name of *akusanori* for soups, as a vegetable, or may even be eaten raw. The sample I happen to possess claims to be especially fine—but it seems rather tasteless to the Western palate. In Great Britain, probably carrageen moss (*Chondrus crispus* and Gigartina spp.) is the most widely utilized of seaweed products, valued for the jelly-like nature of its hot-water extract. In the War of 1914–18, carrageen was in demand to replace gelatin, which was in short supply.

Little seems to be known with any certainty as to the food value of even the most edible weeds. It is usually considered that their mineral content is of value, especially the iodides, which are characteristic of many brown and some red kinds; their gelatinous substances are probably not digested by man, but may be useful in providing bulk without irritation. There are algæ like *Laminaria saccharina* and *Alaria esculenta*, which seasonally store sugars, but it seems doubtful whether these particular sugars can be digested, at least by human beings. It is on record, however, that the digestive juices of snails and limpets are very efficient in this respect.

Seaweeds as food have never been very popular in England, but several preparations are marketed at the present time and sold as "seaweed salt". This is recommended as giving a daily quota of iodine in natural form, to maintain health or to correct deficiency in those with a tendency to goitre. Some of these preparations claim to be the dried and finely powdered weed. In conformity with this claim, the powders, on moistening, swell to a gelatinous mass which has a taste decidedly suggestive of seaweed. The iodine content of certain seaweeds is remarkable in that it has to be derived from the sea water, in which only traces occur. The algæ are believed to absorb water over their whole surface; they must have the power not only to absorb the traces present, but also to accumulate them within. The physiological mechanism of this accumulation is little understood.

Among the brown algæ, the Laminariaceæ are relatively rich in iodine, but the Fucaceæ are also used as sources of iodine in some localities. A number of red algæ also store iodine (for example, species of Iridea and Asparagopsis), while a few have special enlarged superficial cells rich in iodides: these red algæ, however, do not occur in sufficient abundance, at least in Europe, to serve as a source of iodine on any commercial scale.

3. *Commercial products.* The manufacture of potash and other substances from kelp* (derived from the larger brown algæ) fell into disuse in the latter part of the nineteenth century, when cheaper sources were discovered from mineral deposits. In the present century, interest has grown in the algæ as a source of mucilaginous substances utilized in many ways, especially in Japan, Great Britain and the United States. These mucilaginous substances can be divided roughly into two classes with differing chemical and physical properties: those from the brown and from the red algæ respectively.

The mucilaginous products of the higher brown algæ can be extracted by boiling the fresh material with a dilute solution of sodium carbonate. After a time, the tissues swell and lose their shape; the mass is then filtered through cloth, and on acidifying there forms a thick, slimy substance recognized by Stanford in 1862 as of definite chemical composition and named by him first algin, later alginic acid, since it formed a series of metallic salts, like a true acid.

In recent years, algin and its derivatives have been utilized for many commercial purposes. A study of the many patents granted in this period reveals something of the progress which has been made both on the technical side and in the chemical knowledge on which that progress must be based. It has been found, for example, that when treated with vulcanizing agents, such as carbon disulphide or carbon tetrachloride, algin becomes a rubbery mass, which has been used to make rollers for typewriters, among other things.

By violently agitating an alkaline solution of algin with which a small proportion of tannic acid has been mixed, the whole emulsifies and may be poured upon a glass or polished surface, giving a transparent film resembling 'Cellophane'. It is claimed that this film is cheap, almost non-inflammable and less influenced by light than true 'Cellophane', which is apt to become very brittle. It has already been widely used as an inexpensive transparent wrapping for various classes of goods, or, at least, it was so used before restrictions on wrappings were in force.

The purified alkaline extract of the fresh seaweed may, alternatively, be forced through a fine aperture, forming a viscous thread which is then spun into a bath containing a mixture of furfurol, caustic soda, formalin and other substances. By this means a kind of 'artificial silk' is produced, which after further treatment is washed and finally sized with an ammoniacal solution of algin under pressure.

This thread, however, as first produced, was not strong enough for weaving, and moreover was not sufficiently resistant to soaps containing a proportion of alkali. Further processes involving treatment of the thread with salts of chromium or beryllium are alleged to have overcome these difficulties. The chromium salts, being coloured, were not so suitable for subsequent dyeing, but the beryllium salts appear to be free from this objection. The strengthened thread so obtained will, no doubt, be tested in due course for weaving.

The Japanese claim to have produced an artificial wool from gulfweed (Sargassum spp.) by spinning the viscous thread into a bath, which had a crimping effect.

In recent years, salts of alginic acid have been obtained from species of Laminaria collected on the Atlantic coasts of Scotland. From this source, the firm of Albright & Wilson have been able to market a purified form of sodium alginate which has been given the trade name of 'Manucol'. The white powder dissolves in water to form extremely viscous solutions which are tasteless, odourless and almost colourless. It is claimed that these powders or their derived products have been utilized in connexion with a variety of industries, including production of food and medicines, and the manufacture of cosmetics, textiles, transparencies and plastics.

Alginates may be added to milk previous to the manufacture of milk powders; in this way, the milk can be reconstituted by the addition of water, without causing sedimentation. Cocoa may be rendered more 'soluble' by a similar addition.

The colloidal properties of alginates render them especially suitable as a base for creaming agents, for car polish and even for boiler feeds to prevent the deposition of 'fur'. In these and a number of other commercial products, alginates behave as 'protective' colloids, helping to keep in suspension or emulsion particles which would otherwise tend to settle as a sediment.

Although so many uses have been found for the salts of alginic acid, the chemical composition of the acid itself has been a subject of controversy. Stanford concluded that the molecule was a large one, including nitrogen ($C_{76}H_{80}N_2O_{22}$), but later work with purified materials has established that it is a polymer of *d*-mannuronic acid. Experiments of Bonniken appear to indicate that treating the alkaline salts with astringent agents causes a progressive polymerization of the original algin molecule, giving longer and more complex chain structure. It is these long-chain molecules which are important for the production of textile threads and are susceptible to contraction, giving the possibility of a crimping effect.

Two classes of colloidal substances can readily be extracted from red algæ, namely, mucilages and gels. The former may be dissolved out with cold or tepid water, the latter by boiling for a short time.

In Japan, at Osaki, a kind of seaweed glue called 'funori' is made from species of Gloiopeltis (chiefly *G. coliformis* and *G. intricata*). It is used for adhesives and for sizing paper, fibre or cloth. A more valuable product is agar-agar, the commercial name given to the gelatinous substance extracted by boiling water. During the last two decades, agar has been widely used in connexion with foods and medicines. As a laxative, it absorbs and retains water, besides acting as a lubricant. It is almost universally used as a basis for bacterial and fungal cultures, resisting liquefaction. Recently, however, a strain of bacteria, *Vibrio agarlyticus*, has been isolated which liquifies agar but not cellulose.

By far the greater part of the world's supply of agar came from Japan, but a considerable quantity has also been manufactured in California, though much is not sufficiently pure for bacteriological purposes. At the present time, investigations are being carried out in the United States and other countries, with the view of developing local supplies. The rich algal flora of the coasts of South Africa and New Zealand and of the west coasts of North America and Canada offer many possibilities, but even in the U.S.S.R. during the last ten years, an agar-producing industry has apparently been developed, utilizing algæ which occur on their maritime coasts and on the shores of the Black Sea. It has recently been announced that agar suitable for bacteriological purposes has been obtained from certain seaweeds in South Africa, New Zealand and in Britain. This is being further explored.

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* 'Kelp' was the name originally used for the ash of the larger brown seaweeds after burning. In America it has also been applied to the various brown algæ used for this purpose.

To obtain a pure agar, the freshly collected algæ are bleached in the sun for some days, the process being hastened by sprinkling at intervals with fresh water. The bleached algæ are then boiled with water (Japan) or treated with steam (United States) and the resulting mass strained through cloth. The clear liquid is poured into shallow troughs to set, and the jelly cut into narrow strips. In Japan, the process is carried out in cold weather, so that the strips contract, expelling water ; in the United States the same result is obtained by artificial refrigeration. In either case, the expelled water is drained off, and the remaining jelly dried and shredded for packing.

Agar prepared in this manner has been analysed and is described as "a galactan with sugar units of unusual structure". Carrageen mucilage from *Chrondrus crispus* is a "polysaccharide ester of sulphuric acid by the acetolysis of which two galactans were isolated". Both these products are water soluble. According to Tschudy and Sargent, the two American species of Gigartina require a preliminary soaking and subsequent boiling in lime water or 2 per cent calcium chloride in order to extract a substance giving a firm jelly. Subsequent treatment (straining, cooling and drying) appears to be the same as for the water-soluble derivatives of other types. It appears, therefore, that a number of different but probably closely related substances with similar physical characteristics are included under the general term agar. The amount which can be extracted appears to be very variable. One of the best sources, the Japanese *Gelidium amansii*, is said to yield 25–35 per cent of its dry weight as agar.

The commercial utilization of seaweeds raises many issues. Having regard to present difficulties of overseas transport, it would seem natural to seek supplies from our own shores, possibly from the west and south-west of England, and the west and north-west of Scotland. The shores must be far enough from towns to escape serious pollution from sewage, yet sufficiently accessible to the collector and to transport for the material collected. For most purposes, probably, the dried seaweed would suffice, and it could be washed and dried on the spot, before packing.

When harvesting is regularly practised, it may be necessary to restrict the season of cutting and to regulate it in such a way that regeneration may occur by natural means. Much more information is needed as to the requirements of seaweeds for healthy growth and the reasons underlying the present distribution, especially of useful types. It is very probable that advances along these lines would lead to successful cultivation of desirable types like *Gracilaria confervoides, Ahnfeldtia plicata* or *Gelidium corneum*, which are fairly common in some localities, or of *Chondrus crispus* and *Gigartina stellata* Batt., which are already known to be abundant in certain areas.

The commercial utilization further demands much work on the biochemical and technical side before the final stages of marketing can be reached. We thus require the services of the botanist, the ecologist, the biochemist, the technician and the financier. Yet the last word remains with the botanist, who combines the experience and judgment of a systematist with the practical knowledge of the ecologist. For, in order that analyses may bear fruit, it is necessary that the right type of alga should be recognizable and recognized, its course of life understood and its reproductive periods utilized to the full.

PHYSIOLOGY OF THE LUNG

By DR. O. A. TROWELL,
University of Edinburgh

PROF. B. Narayana, in his presidential address to the Physiology Section of the thirtieth Indian Science Congress held in January last, took as his subject "The Growth of Physiology as an Experimental Science". After tracing the history of experimental physiology from its origins with Ludwig and Claude Bernard, and giving some account of its current status, he proceeded to a review of recent work on the vasomotor and bronchomotor mechanisms of the lung, which subject he chose as an illustration of modern methods and the modern outlook in experimental physiology. This field of research has been developed chiefly by Prof. de Burgh Daly and his colleagues, first in Birmingham and later in Edinburgh. Prof. Narayana himself collaborated in some of the work in Edinburgh, and later he and his colleagues in India have made further contributions of their own.

In considering the physiological activity of the lung itself, we may remark that its respiratory movements are merely a passive response to changes in the capacity of the chest, that the gas exchange between blood and air is simply a process of physical diffusion, and that the only known physiological variables intrinsic in the lung itself are the calibre of the blood vessels and the calibre of the bronchi. The calibre of these tubes is controlled by the plain muscle fibres which form a large part of their walls. Vasomotor and bronchomotor changes, therefore, seem to be the principal intrinsic activities of the lung which call for investigation, and this is the field which Daly and his colleagues have successfully explored.

In the physiological investigation of any bodily organ there are, broadly speaking, two alternative lines of attack available. The first, or analytical, method seeks to isolate the organ in question from the disturbing influences of the rest of the body, preferably by excising it altogether, and, keeping it alive under fully controlled but somewhat artificial conditions, to analyse its functional responses to controlled stimuli. The second, or synthetic, method seeks to establish the part played by the organ in the integrated life of the whole animal, how it influences, and is influenced by, changes occurring elsewhere in the body. In the first method natural conditions must be sacrificed in order to secure full experimental control, and the results obtained indicate the physiological potentialities of the organ rather than its normal behaviour in the whole animal. The second method sacrifices full experimental control in order to maintain a natural condition of the organ; the results generally lack the scientific certitude associated with the former method, but when significant they reveal more truly the role of the organ in the normal life of the animal.

Daly, in his work on the lung, adopted the analytical approach. His success has been due in the first place to the development of a skilful technique whereby the lungs can be removed from the body and kept alive for several hours under artificial conditions, the blood circulation and respiratory movements being maintained by suitable pumps. The lung inflation, blood pressure, blood flow and other factors were under complete control and were recorded continuously. A second factor, no less essential to success, arose from an anatomical consideration. It was known that in addition to their main supply from the pulmonary artery, the lungs also receive a small vascular supply from the systemic circulation by way of the bronchial arteries. These vessels supply the walls of the bronchi and those of the pulmonary arteries together with their associated nerves and ganglia. In preliminary work, Daly traced the territorial distribution of the bronchial vascular system in the lung; he showed that there is a capillary anastomosis between the bronchial and the pulmonary circulations in the region of the respiratory bronchioles, and he was the first to realize the physiological importance of the fact that the arterial and bronchial musculature, with their associated nerves, the very tissues the responses of which were to be the subject of investigation, received their oxygen supply and nourishment exclusively from the bronchial circulation. He therefore devised a method for the separate perfusion of the bronchial circulation as well as the pulmonary circulation in the isolated lung. Previous workers on the isolated lung had perfused only the pulmonary vessels, and their usual failure to obtain vasomotor responses was therefore only to be expected. The technique of the 'isolated perfused lung' had to be perfected before any worthwhile investigations were feasible.

The results obtained have provided convincing evidence of the existence of a nervous vasomotor control of the pulmonary circulation; the earlier evidence had been unsatisfactory. The vasomotor and bronchomotor responses to the stimulation of various nerves and to the injection of various hormones and drugs were fully investigated in several species of animal—guinea pig, cat, dog, pig and monkey. The particular responses obtained varied considerably from species to species and also under varying experimental conditions in any one animal, so much so that no simple or uniform picture emerges. This is characteristic of modern physiology; the more intensively a phenomenon is investigated the more complex is it revealed to be, and the final picture ever recedes from sight. Every day the apparently simple phenomena of classical physiology grow more and more complex as they are subjected to the more searching analysis of modern technique.

With regard to the vasomotor responses, stimulation of either cholinergic (vagus) fibres or adrenergic (sympathetic) fibres most commonly produced vasoconstriction, but in certain defined circumstances vasodilation could result from either. Injection of acetyl choline or adrenaline gave parallel results. The bronchomotor responses were similarly variable, depending on the species and the experimental conditions. The detailed findings are of considerable interest, particularly in their relation to current theories of chemical transmission in the autonomic system, but space does not permit their discussion here.

Perhaps the most significant outcome of this work is to be found not in the detailed findings, but rather in the very variability of the responses obtained; the fact that a given nerve or a given hormone can produce in certain circumstances a constriction and in other circumstances a dilatation in one and the same preparation is in itself of the greatest physiological importance, and suggests many hitherto unthought-of possibilities with regard to the occurrence of similar changes in the whole animal. The problem of the bronchospasm in asthma, for example, can be considered in quite a new light as a result of these researches. It must always be remembered, however, that the isolated perfused lung is surviving under highly abnormal conditions and probably its behaviour is correspondingly abnormal; so the transference of these results to the whole animal and to man is at present not justified. The potentialities of the lung have been revealed; to what extent they operate in normal life remains to be discovered.

Prof. Narayana concluded his address with a plea for the further development of experimental physiology in India. He himself is already contributing to this end in the active research which he has initiated in his own department at the University of Patna. We can wish our Indian colleagues well in their pursuit of the common ideal, and we shall look forward to their contributions to the further growth of the science.

OBITUARIES

Mr. William Hartree, O.B.E.

A REMARKABLE fact about William Hartree, who died on April 27, 1943, was that his first scientific paper appeared (in 1920) when he was fifty, his last (in 1941) when he was seventy-one. In those twenty-one years he published ten papers alone and thirty-six in collaboration (in *J. Physiol.*, *Proc. Roy. Soc. A* and *B*, *Phil. Trans. A* and *B*, *Phys. Rev.*, *J. Sci. Instruments*, *Proc. Camb. Phil. Soc.*, and *Biochem. J.*).

In the strictest and best sense, Hartree was an amateur; he worked for love of his work and, I think one dare say, of his collaborators. But he worked also with the intensity and pride of a craftsman in his job, and for all his steadfast modesty, he knew, like a craftsman, when he had done it well, and he worked with quite inflexible devotion. During the War of 1914–18, at Whale Island, he said —almost seriously—that he was going on strike for more work and less pay: his pay could not have been much less nor his work more. I had to stop him then from trying to get into the army at forty-seven —because he was enjoying that work too much! Later, at Cambridge, when I pressed him once to take a holiday, he wrote me next day "I have taken a holiday to-day—made a new kind of experiment"—the only kind of holiday he liked.

Hartree was known, except by his work, to very few: he never attended meetings: he wanted no credit or praise for what he did. He almost seemed to prefer to do a difficult job well rather than make it easy. He was ready to face the most laborious calculations in order to obtain a result; he almost resented at first any improvement in technique which made calculation simpler. In his work with me on the physiology of muscle he reckoned that he had written down between 10^7 and 10^8 figures, and we very seldom discovered a mistake. He was always ready to take a sporting chance to see what he could make of a new job—as when he took up research on A.A. gunnery in 1916, when he turned (a mathematician and engineer) to experimental physiological research in 1919, when he took to the theoretical study of atomic structures in 1933 and to the numerical solution of certain partial differential equations, concerned with motion in a viscous fluid, in his last years. Yet in some ways he was very conservative; for thirteen years his chair in the physiological laboratory at Cambridge, where he did his arithmetic, was precariously balanced on four old fuse-tins of the last war, when it would have been easy to lengthen the legs or even to screw the fuse-tins on ! He was not an original or brilliant thinker, though he was obstinately independent when he knew he was right ; he preferred always to help others, and this note is written, in gratitude and affection, by one whom he helped full-time for seventeen years.

Hartree was born on April 8, 1870, the son of John Penn Hartree, F.R.C.S. His mother was the daughter of Samuel Smiles, author of "Self Help" (1859) and many other works. J. P. Hartree was the son of an able engineer and, like his son, was educated at Trinity College, Cambridge ; he obtained a first-class in the Natural Sciences Tripos (1865). Later he practised, and attended various hospitals in London, but when his son Willie was six years old moved to Belfast. He passed on his temperament and abilities to his son : retiring, silent, able, kindly, with the same high standards and perfection of work. He was a well-known member of the Alpine Club.

From Belfast, W. Hartree went to Tonbridge School and later to Trinity College, Cambridge, where he was eighteenth Wrangler in 1892. Then after a short apprenticeship in electrical engineering he lectured and demonstrated in the Engineering Department at Cambridge until 1913. He married in 1895 his cousin Eva, daughter of Dr. Edwin Rayner of Stockport (sometime treasurer of the British Medical Association) and of J. P. Hartree's sister, and sister of Dr. E. H. Rayner, late of the National Physical Laboratory. Mrs. Hartree has been mayor of Cambridge (his friends always wondered what sort of 'mayoress' Hartree made !) and has done distinguished public work in many fields. Of their five children, only one survives (Prof. D. R. Hartree of the University of Manchester) ; a younger son who had been a 2nd lieutenant in the Royal Artillery and had worked, like his father and brother, at Whale Island on A.A. gunnery, died soon after the War of 1914–18.

In 1913 Hartree retired and went to live in Surrey, where he busied himself with experimental wireless. Early during the War of 1914–18, he joined up for work with the G.P.O. and served—with his usual devotion and humility—as a telegraph linesman. In 1916, when R. H. Fowler and I were starting up what later became the Anti-Aircraft Experimental Section of the Ministry of Munitions, Hartree, at E. H. Rayner's suggestion, came to join us. It was hard to believe that this shabby, middle-aged linesman, offering to work for love, was an able mathematician and engineer—but he was, and much more. Whenever a job of hard work had to be done on time, whenever some difficult observations were to be made, whenever something was to be fetched or carried, whenever long hours and discomfort to be endured 'at the far end of the base', Hartree was there. Nobody could see shell-bursts so nearly into the sun, nobody could record what he saw so accurately and quickly, nobody could interpret the results so well, nobody would come so early to the office or stay so late to work them out. Quietly, one day, he improvised a long-base height-finder out of some wires, posts and a steel tape. It came to be called the Hartree height-finder and was used extensively by the troops until sufficient monostatic optical height-finders were produced ; perhaps that was why he was given an O.B.E. Once he was arrested on the beach near Great Yarmouth during a gun-trial, for communicating with the enemy by means of an ordinary field telephone laid along the shore. Once, he was driven to writing verse because the captain of a monitor refused to fire his A.A. gun on a Sunday, the only fine day for three weeks. On Christmas Day 1918 he sent me the four volumes of his grandfather's book "Lives of the Engineers", with a note thanking me for my kindness. Everyone else—by then we numbered forty or so—knew who ought to be thanked.

When it was all over, the arithmetic finished and the instruments packed up, Hartree came to me with a long face and said it was a bad business ; he had never enjoyed anything so much, now what could be done about it. Having no intention myself but to return, after nearly five years absence, to physiology, and being young enough to believe that I could (it will be harder this time), I said "Why not come and do physiology at Cambridge ?" So Hartree was set to read Bayliss' "Principles of General Physiology", and in a few weeks returned and said that he had not known before that physiology was as interesting as that, and he would come ; which he did, for fourteen years. We started off in 1919 on the physiology of muscle, its heat-production, its dynamics, its recovery processes and its various peculiarities ; and Hartree learned to make and manage thermopiles, levers, galvanometers, oscillators and Ringer's solution ; and—what is much harder for an engineer—to dissect the muscles and nerves of frogs, tortoises and hedgehogs and keep them alive and working. The observations required skill and patience, and the records needed a deal of measurement and calculation—so much the better ! Hartree was the first to discover what ought to be called the 'Hartree Effect', that of after-exposure in intensifying photographic records.

I left Cambridge in 1920 for Manchester, moving to London in 1923, but Hartree carried on the work in Cambridge until 1933. On the physiology of muscle and allied subjects in that time came ten papers under Hartree's name alone in various journals, twenty-four under his name and others. We kept in continual touch by post and by as frequent visits as I could pay. I found him always either with his apparatus in a dark room, or perched precariously on his chair on the fuse-tins, doing the arithmetic ; never absent, however unexpected the visit. He arrived first in the morning, he usually left last at night—for love.

It would not be fitting, in such joint work, for me to assess its value ; but such value as others may attribute to it is due in large part to my collaborator—it certainly would not have been done without him. Some record of part of it is given in "Adventures in Biophysics" (1931).

By 1933 physical disability had made it difficult for Hartree to stand for the long hours necessary in the experimental work, and he felt also that the job which he had set his hand to in 1919 was more or less finished. He turned to his son, D. R. Hartree, for a new one. Fortunately, there were plenty of them that could be tackled at home, and of the kind that needed his patience, accuracy and planned methodical style. The main field of this work was in the calculation of atomic structures, but in the course of time he gave most valuable help in other fields, in particular in some exploratory work on a method for the numerical solution of partial differential equations, in the application of this method to the boundary layer equation in the motion of a viscous fluid, and in connexion with the gas flow in a tube. I gather from his son that his contributions to the practical calculation of atomic structures have been substantial and important. This work is not routine computing; it is essentially a matter of successive approximations, involving making and adjusting a set of estimates until a set of results, derived from these estimates by calculations which may take a week or two, agree with the estimates themselves; it needs understanding and judgment, far beyond that required for routine arithmetic.

The common experience of father and son at Whale Island, in trajectory and similar work, meant that they could talk the same language of methodical calculation, and another happy and fruitful collaboration developed, lasting until Hartree's death. Their joint papers are to be found particularly in *Proc. Roy. Soc. A*, from 1935 to 1939, while papers by Hartree and M. F. Manning are in *Phys. Rev.* 1940 and 1941. As D. R. Hartree wrote me, "I regard his work for Cu as a considerable technical feat; one aspect of it is that it forms the solution of a system of 34 simultaneous non-linear differential equations!"

This work with D. R. Hartree was done with the same "good companionship" (as E. A. Milne, another of the Portsmouth party, called it) as his previous work with others. "My father," D. R. Hartree writes, "once protested that he did not know the basic theory of the atomic work well enough to be cross-examined on that part of the papers, and so did not think that his name should appear on the title-page." Exactly the same diffidence had appeared in his earlier collaboration with others. "He would have been quite content with a formal acknowledgment at the end, and would not have been particular even about that. But his contribution in these papers was really the main one, without which they would not have been, and it would have been grossly unrepresentative of our relative contribution to the work if it had been published in papers under my name alone." As in physiology, so in atomic physics!

Hartree won a cup for fives at school, his handica at golf came down to four, he was a good hand a tennis and bridge, and his collection of 'postage paid postmarks is said to be unique in range and completeness. But of such things he never spoke. Fo many years before 1916 he had worked, no doubt, a methodically and as carefully as he did later; bu there is no printed record of the result. It is strang to think that the method of those ballistic calculation and carefully digested records of observations a Whale Island, and the 'good companionship' of th partnership there, could find so far an extrapolatio to physiology and atomic physics at the hands c this shy, gentle, kindly man. The greatest discoveries however, are made by keeping one's eyes open an one's mind alert for the odd things that turn up—i human relationships as well as science. Hartre turned up in 1916, and those who knew and worke with him since then are richer in both.

A. V. HILL.

WE regret to announce the following deaths:

Mr. W. R. Bousfield, K.C., F.R.S., an authorit on patent law, on July 16, aged eighty-nine.

Prof. H. L. Demler, formerly professor of physic in the Technische Hochschule, Dresden, later hea of the Department of Physics, University of Istanbu and finally visiting professor in Rutgers Universit on March 22, aged sixty.

Dr. Gerard De Geer, the eminent Swedish geologis aged eighty-four.

Mrs. E. C. V. Mattick, research worker in dair chemistry in the National Institute for Research i Dairying, Reading, on July 18.

Prof. E. P. Stibbe, University professor of anatom in King's College, London, on July 23, aged fifty-nin

Mr. Fred Stoker, the well-known horticulturist an author on gardening topics, on July 20.

NEWS and VIEWS

Prof. R. A. Fisher, F.R.S.

IT has been announced that the chair of genetics in the University of Cambridge is to be filled by the appointment of Prof. R. A. Fisher, who has been Galton professor in the University of London since 1933. Before that time he was head of the Statistics Department at Rothamsted Experimental Station. Prof. Fisher has been actively associated with genetics since 1918 when he showed that the biometrical correlations observed between relatives were to be expected on the Mendelian theory. He has written extensively on the action of selection, and he has shown that the manifestation of any gene must be regarded as modifiable through the action of selection on other genes in the nucleus. This culminated in his well-known theory of the evolution of dominance by selection and in his analysis of the genetical basis of mimicry and natural polymorphism. The mathematical theory of selection in relation to variation and mutation was further developed in "The Genetical Theory of Natural Selection" (1930), which also deals with the genetical aspects of human society. As would be expected, Prof. Fisher has been responsible for many improvements in the statistical analysis of genetical result especially in the methods of coping with the peculia difficulties of human data. His early work on th genetical interpretation and statistical analysis o biometrical data has also been extended, notably i a paper published jointly with F. R. Immer an O. Tedin in 1932. This work is perhaps less widel appreciated, largely because geneticists as a bod have been shy of attacking the inheritance of quantitative characters; but interest in this subject is reviving, and Prof. Fisher's findings must have thei influence on future developments here, as in othe fields. It is indeed singularly appropriate that h should both have succeeded Pearson in London an become professor of genetics in the University wher Bateson and his associates did so much to exten and amplify Mendel's results, for no one has playe a larger part in uniting the once conflicting science of biometry and genetics.

University of London: New Principal

MR. HAROLD CLAUGHTON has been appointe principal of the University of London as fro August 1, 1943. Mr. Claughton was educated a

Radley and Trinity College, Oxford. During 1906–1911 e was in India in the Imperial Record Department nd the Home Department, acting occasionally as xaminer in history for the University of Calcutta. He esigned in 1911 and for three years occupied himself vith literary work. He volunteered for active service 1914 but was rejected on account of short sight. n 1915 he was appointed to Military Intelligence, Var Office. At the beginning of 1919 he was appointed assistant secretary, and in November 1920 ecretary, of the Surplus Government Property Disposals Board. He resigned at the end of October 923 as the work of the Board was then practically ompleted. In 1924 he became financial officer and ecretary to the Senate of the University of London, vhich post he held until, in 1929, he was appointed he first clerk of the Court. During September 1939–anuary 1940 he was private secretary to the Minister f Information (Lord Macmillan). He then resumed is duties as clerk of the Court, acting as deputy to he Principal of the University from June 1940 until e became Acting Principal in October 1941. He was warded the O.B.E. in 1918 and the C.B.E. in 1923. He is also an Officier d'Académie Française.

conomics of Reconstruction in Britain

THE Oxford Pamphlet on Home Affairs, "Will the Var Make Us Poorer ?" by M. Young and Sir Henry Bunbury (Oxford University Press. No. H.5.; 6*d.* net), overs some of the ground of the Planning broadsheet 'Financial Mysticism" and is a valuable contribution o the lucid thinking required in the appraisal of the Beveridge and other proposals for post-war reconstruction. The authors point out that the only real limits on production are set by the available skill, equipment and organization, and that money for the individual and money for the nation as a whole have very different functions to perform. They also give warning against the restrictionism that involved us in disasters in 1919 and 1922, as well as against the anger of spending too fast after victory is won. Mr. Young and Sir Henry Bunbury then discuss three typical questions which the ordinary man is asking imself: Where does all the money come from ? Do rivate savings do any good ? Shall we be poorer after the War ? The clear answers given to these uestions lead to the conclusion that a few hard and difficult years may, provided we have vision and courage and seize our opportunities, lead us to a better and more securely based society than for many ecades. Good organization will be essential, including good monetary organization, with money not as controller but as a servant of human affairs. The uthors insist that we cannot again afford to waste ur resources of men and material; we cannot fford unemployment, or to lose great slices of our potential national income by wasting our resources. They are equally emphatic that the expenditure equired to rebuild Britain, to implement the Beveridge Plan, and to raise the standard and quality of living or the people of Britain, can be provided if our great uman resources are properly utilized and co-ordinated with the resources of other nations.

Water Requirements of Rabbits and Guinea Pigs

THE prevalent idea that rabbits and guinea pigs do not drink still persists widely in spite of all that has een written, said and broadcast. Prof. E. L. Kennaway directs attention to this false impression in a ecent issue of the *British Medical Journal* (1, 760; 943), where he reports that a 2·5-kilo rabbit on a dry diet will take approximately 160 c.c. of water, or 65 c.c. per kilo, daily, which is approximately twice the intake of an average human adult derived from both food and drink. It appears that rabbits fed mainly on a dry diet suffer from both water and food starvation, which is indicated by poor condition and scanty contents of the gut found post-mortem. If such an animal is provided with water, it takes a long drink and then greedily eats the dry food. It is obvious that water is essential for the normal physiology of the rabbit; the flesh (muscle and fat) of mature rabbits contains approximately 67 per cent moisture (King Wilson and Botham, 1934), being higher in males than females fed on similar diets. In comparative tests in feeding (*a*) dry mash and greenstuff, (*b*) dry mash and water and (*c*) dry mash, greenstuff and water (Christian, 1936) the best growth and development was obtained by (*c*), whereas (*a*) without drinking water caused impaction of the cæcum. Deprivation of water results in loss of appetite and a decline of 20 per cent in fur growth (Wirth, 1936).

Whether or not a rabbit will drink depends upon the moisture content of the diet; for example, a mixture of roots or potatoes and hay provides sufficient moisture (Brüggemann, 1937) for maintenance, whereas cereal grains and meadow hay required approximately 130 c.c. additional drinking water. When fed hay only, they drank about 150 c.c. of water but individual rabbits varied greatly (118–200 c.c.), requiring more in hot weather. Replacement of dry mash by fresh tea leaves in mixed diets resulted in a marked decline in water drinking (King Wilson, 1942). For production requirements the water supply is even more important. Although there is more dry matter in rabbit's than cow's milk, deficiency was seen to cause urine drinking and is one of the causes of cannibalism. Very similar results were observed with guinea pigs on restricted green-food diets.

Bell Laboratories Rubber Research Laboratory

ACCORDING to an article (*Bell. Lab. Rec.*, 21, No. 8; April 1943) by F. S. Malm, the Bell Laboratories have for many years been actively engaged in research on the chemical and physical properties of rubber and its compounds, to determine the kind of materials required to withstand severe weathering and the constantly changing conditions of temperature, humidity and light exposure. Most of the work has been directed to improving insulating materials made from plantation rubber, but an increasing part has been directed, during recent years, to synthetics such as Buna S and neoprene. Extensive studies have been carried out on insulation for submarine cables leading to the development of Para-gutta and pressure-equalizing materials for loaded telegraph cables. Insulation has been developed for coaxial cables and more recently dielectric materials for ultra-high frequency and micro-wave cables. Rubber jackets were also devised to protect against corrosion in the trans-continental cable being laid between Omaha and Sacramento.

About a year ago the Rubber Group moved to new laboratories at Murray Hill where complete facilities have been provided for studying rubber and its synthetic substitutes and for improving them. In anticipation of a peak load in this work additional equipment was installed including mixers, vulcanizers and apparatus for physical and chemical tests. All of this rubber-working equipment is provided with auxiliary apparatus for controlling and recording temperatures, pressures and power consumption. The laboratory rooms are unique in that any of fifteen different services including electric power, air pressure, vacuum, hot and cold water, hydrogen, oxygen and nitrogen in addition to illuminating gas are available at any bench or can easily be made so. To improve the desirable characteristics of a rubber material and suppress the undesirable ones the rubber research organization endeavours to relate the physical characteristics of elastic materials to their molecular structure. Special apparatus is used in studying what happens to the rubber molecules when they are compounded, vulcanized, and destroyed through use. These studies on the mechanism of vulcanization, viscosity, molecular weight and brittleness of rubber and allied substances are associated with current synthetic rubber problems.

Photography of Stars in Daylight

Many years ago it was predicted that stars close to the sun should be visible to an observer using a suitable technique. Only recently, however, has such a technique been developed, primarily for investigating the solar corona without waiting for a total eclipse. News has now reached Great Britain that a Swiss attempt to photograph stars in daylight with the aid of a coronagraph has been successful (M. Waldmeier, *Z. Astrophys.*, 21, 269 ; 1942). A photograph obtained at Arosa, at an altitude of 2,050 m. in the Alps, shows Regulus (mag. 1·34) quite clearly at a distance of 12′ (less than the sun's angular radius) from the edge of the solar disk. The observation is possible only by eliminating so far as possible diffracted and diffused light in the apparatus, and by observing at a great altitude to avoid meteorological scattering. The successful photograph was obtained at midday on August 22, 1941, with a 15-sec. exposure through a red filter. Regulus is the only first-magnitude star within 1° of the ecliptic, but there are a number of fainter stars (down to third magnitude) which, it is considered, could be photographed in favourable conditions.

One obvious application of the method is to the measurement of the gravitational deflexion of light. The Einstein effect has been observed at several eclipses since 1919 at considerable expense and with many disappointments, and the results have not been all that could be desired. The coronagraph method, if it can be developed so that precision measurements are possible (at present the objective is an uncorrected single lens, though the field which must be covered is at least 1° in diameter), will have many advantages. Accidental errors could be considerably reduced by multiplication of observations, for example, and the photographs would be taken under favourable working conditions at an established observatory instead of in the somewhat hectic circumstances of a total eclipse.

Health of New Zealand

In his annual report for 1941–42, Dr. M. H. Watt, the director-general of health of New Zealand, states that during this period cerebrospinal fever has become epidemic on a small scale, as is shown by the fact that in the whole country there were 163 cases with 25 deaths among 1,538,620 Europeans, while there were 47 deaths among about 87,000 Maoris. It was found that the meningococcus was widespread among the employees at a freezing company, which suggested that the effect of the intense cold on the nasal mucou membrane lowered the local resistance so as to allo penetration of the organism. Of recent years ther has been a considerable increase in known syphili throughout New Zealand, the number of cases treate at the clinics being 156, 192, 285 and 403 during th last four years. There has also been a sharp rise i notification of males suffering from tuberculosis similar to that found in all the Allied countries an attributable to the special methods employed in th examination of recruits. As regards vital statistics the birth-rate in Europeans was 22·81 and the death rate 9·81, while in Maoris these rates were 44·77 an 20·59 respectively. The infant mortality of th Maoris was 125·06 as compared with the Europea rate of 29·74.

Sudden Rise in Birth-Rate in the United States

According to an editorial in the January issue o the *Statistical Bulletin*, the organ of the Metropolita Life Insurance Company of New York, fairly complete data for 1942 for five large cities in the Unite States, namely, New York, Boston, Baltimore Washington, D.C., and New Orleans, show no only that the general level of births for 1942 i materially higher but also that the profile of th curve is completely changed. Instead of a sprin and a summer maximum there was a strong upwar movement of births beginning about September an continuing almost unbroken to the end of the year Moreover the level for the entire year is far abov that of the period 1938–1939. The sudden increas in births in September and October 1942 would seem to be connected with the outbreak of war in Decembe of the previous year.

Recent Earthquakes

The United States Coast and Geodetic Survey, i co-operation with Science Service and the Jesui Seismological Association, has determined the epicentres of three recent earthquakes. The first occurre on March 7 at 3h. 01·5m. U.T. from an epicentr situated 57° N. lat., 164° E. long. This is in th Pacific Ocean near the east coast of central Kamchatka Peninsula. The second and third were bot on March 9, at 3h. 25m. 32s. and 9h. 48m. 37s. U.T respectively. The first on March 9 was from latitud 42·2° N., longitude 80·9° W., which is in the bed o Lake Erie to the west of Erie (city) and north-north east of the city of Cleveland, and the second o March 9 from an epicentre at latitude 56° S., longitud 22° W., which is in the south Atlantic east of th island of South Georgia. All interpretations an calculations are tentative.

Announcements

At the recent annual meeting of the Genetica Society the following officers were elected : *President* Dr. C. D. Darlington ; *Vice-Presidents*, Dr. R. N Salaman, Prof. T. J. Jenkin, Prof. R. A. Fisher *Treasurer*, Miss E. R. Saunders ; *Secretaries*, M E. B. Ford, University Museum, Oxford ; Mr W. J. C. Lawrence, John Innes Horticultura Institution, Merton, S.W.19.

Erratum.—In the News and Views "Announcements" in Nature of July 10, we regret that w announced Dr. R. R. Mimms as being appointe lecturer in physics in the University of Birmingha This is incorrect ; for Dr. R. R. Mimms read D R. R. Nimmo.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Research and Ships' Antifouling Paints

A sub-committee of the Iron and Steel Institute recently produced the first report of the Marine Corrosion Sub-Committee. This was anticipated by the presentation of two papers dealing with the same subject. One was by Dr. G. D. Bengough and Mr. W. G. Shepheard in London, at the Institute of Naval Architects, on April 15, 1943, and the following day a very similar paper by Dr. Bengough in Newcastle-upon-Tyne at the North East Coast Institution of Engineers and Shipbuilders. These papers dealt with he work of the sub-committee carried out by the official investigator, Dr. J. C. Hudson, under the chairmanship of Dr. Bengough.

It is not proposed here to criticize technically the points of difference which research workers in the industry have with the findings of the Committee, as his has been dealt with fully in written communications to the societies at which the papers were presented. What I wish to set forth here is that the whole attitude of this new sub-committee, and the reasons for its being created, seem to have been based on the assumption that no serious research work had been done on this subject; this is very far from being true.

The suggestion underlying both the papers and the report is that manufacturers have no idea how their products function, and shipowners do not receive compositions best suited to their purpose. This is quite contrary to fact, as indeed many members of the antifouling paint industry have carried out intensive research over many years, but, of course, have not published their results, as these would be of benefit to competing firms both in Great Britain and abroad. In the early days of the industry, researches were mainly by trial and error, but it must not be overlooked that these methods resulted in quite good antifouling paints. About twenty-five years ago, to my knowledge, this method of approach had reached its limitations, and research work on strictly scientific lines by scientific men appointed for this purpose, and in no way responsible for production, was instituted. This necessitated fundamental biological work into the life-histories, methods of attachment, and reactions of marine organisms to poisonous and non-poisonous surfaces. Alongside he biological work, research in the laboratory for new and better toxins had been continuous. One new toxin, fully tried and proved, has been used in antifoulings now for twelve years or more.

In view of the above facts, it is surprising that public money and effort by scientific men is used in an endeavour to undertake work which has already been done. No one will question the importance of preventing fouling, and so maintaining maximum peed, or conversely minimum fuel consumption, in peaceful times; and under war conditions it assumes a vastly greater importance. Nevertheless, the fact does remain that the industry is capable of supplying compositions which provide longer periods of immunity from fouling than those in general use, or even those used by the Admiralty, so the work of he Committee is redundant. There are, no doubt, easons which influence shipowners not to choose the most efficient available paint, and they are presumably satisfied with what they use, which shows, at any rate, that the industry is ahead of shipping requirements, entirely due to the composition manufacturers' scientific research. It shows also that the work on antifoulings as so far carried out by the Marine Corrosion Sub-Committee is quite unnecessary; on the other hand, research of a purely academic character would be welcomed by scientific workers in the industry.

Although research work by the industry had not been published, nevertheless before the formation of this Sub-Committee, Dr. Hudson, the official investigator, was commissioned by the Admiralty to carry out investigation on existing commercial brands of antifouling compositions, and some six gentlemen, including Dr. Bengough, the chairman, and Dr. Hudson, visited the marine biological testing station of the research department of my Company, where much of the work was gone into in detail. It was assumed that this work for the Admiralty would be confidential, and there was no hesitation on our part in revealing details of that research work. That the Sub-Committee in its report makes no mention of this, and that the greater portion of the report is derogatory to the research done by the industry, is, to say the least of it, somewhat surprising.

There is one final point that I would like to mention—namely, that this industry is primarily British. Those manufacturers of antifouling compositions in foreign countries are, almost without exception, offshoots of some British parent company. The avowed intention of the Marine Corrosion Sub-Committee is to publish details of formulation and manufacture of antifouling compositions which will ultimately, of course, be available to anyone in the world. The effect on British export of such an action as they contemplate is self-evident, and does not need emphasizing.

P. Ewart Bowles.
(Director of Research.)

The International Paint and
Compositions Co., Ltd.,
Grosvenor Gardens House,
London, S.W.1.

Referring to the above letter by Dr. Bowles, I should like to make the following comments.

No statement or assumption has been made by the Marine Corrosion Sub-Committee "that no serious research work had been done on this subject". The Sub-Committee has no detailed knowledge of the amount of work done, the technique or the conclusions achieved by Dr. Bowles and his colleagues, because their researches have not been published and are not accessible to the Sub-Committee, and, therefore, no references can be made to the work. The Sub-Committee believes that, however much has been done, still more is required, partly because the fouling of both naval and merchant vessels is still a serious matter, and partly because of the wide variation in performance of compositions at present on the market made by different manufacturers, and the lack of unprejudiced guidance about their relative values in the different types of conditions to be met on the world's shipping routes.

In support of the first of these statements, I may point out that the Admiralty authorities calculate from their own practical experience[1] that 20 per cent of the total fuel burnt on warships is used in overcoming the retardation set up by fouling organisms;

for the merchant navy it is only necessary to pay a few visits to shipping home in dry-dock from certain world-routes to see that the problem of fouling has not, so far, been solved.

The statement that the anti-fouling composition industry "is capable of supplying compositions which provide longer periods of immunity from fouling than those in general use, or even those used by the Admiralty", but that shipowners do not choose to use them, suggests that the industry has failed to bring its products adequately to the notice of the Admiralty and shipowners, or that these bodies do not take the same favourable view of these products as do the makers, or that the prices charged are not reasonable. Inquiries among merchant shipping companies, particularly those trading to tropical ports, show that improved anti-fouling compositions would receive a ready welcome, provided that they enabled ships to make an additional voyage without docking, and particularly if the paints could be bought to specification and could be produced free of that expensive and scarce ingredient mercury.

The Sub-Committee's work is not a specifically war-time measure; for a country such as Great Britain, which will always be dependent on water-borne transport to bring many of its supplies, and which will still maintain a fleet, the production of the best possible anti-corrosion and anti-fouling paints will always be an important matter. This problem should, therefore, be considered from the point of view of the national interest. In his last paragraph, Dr. Bowles suggests that any successful work achieved by the Sub-Committee would interfere with the export trade of the anti-fouling composition industry, which had almost a monopoly of the export trade in pre-war days. Dr. Bowles should be aware of the immense amount of research work, both in the laboratory and on ships, which is now being done in the United States, which possesses a larger official investigating organization than that of this Sub-Committee. Much work is also being done in Japan, and, presumably, in Germany. All these countries will compete for the export trade in the post-war world, and it is certain that the United States will be in a position to produce paints of first-class quality. In Britain there is no Ships Compositions Research Organisation within which the different firms exchange and develop ideas; each separate firm carries on its own work secretly and must attempt to defend its own position individually. Similar attempts have been made by other firms in other industries, and the result has always been the same—the policy of secrecy has had to be abandoned.

The Sub-Committee is, and always has been, ready to co-operate with the anti-fouling composition industry as a whole on the basis of the free exchange of information; it invited about twenty-five firms to send representatives to a meeting, held at Cambridge in January of this year, at which many university scientific men were present; the Sub-Committee outlined its views on many topics and definitely invited co-operation, but so far no response has been received.

As regards the last paragraph but one of Dr. Bowles' letter, the facts are as follows: On December 7, 1939, a meeting of the Admiralty Corrosion Committee was held at Devonport. The chairman, official investigator and one other member of the Marine Corrosion Sub-Committee attended this meeting by invitation, and on the following day accompanied the Admiralty representatives on a visit to the Biological Research Station at Newton Ferrars, by kind invitation of Dr. Bowles' Company, to whom the Station belonged. Dr. Bowles now says that much of the work being carried on was gone into in detai and that this work was regarded as confidential; in the next sentence he complains that no mention of it is made in the Committee's report. My own recollection of the matter, three and a half years after the event, is that most of the time was taken up with a visit to the rafts anchored in the estuary for the purpose of testing paints, and an inspection of some of those paints after they had been lifted from the water. No disclosure was made as to the formulation of the paints, and no advantage was taken by the Sub-Committee of any details divulged about the rafts themselves, as decisions had already been taken about the arrangements of the Sub-Committee's own rafts. It is a little difficult to see what information Dr. Bowles expected the report to contain about this visit, which took place more than three years before its publication.

G. D. BENGOUGH.
(Chairman, Marine Corrosion
Sub-Committee.)

Iron and Steel Institute,
4 Grosvenor Gardens,
London, S.W.1.

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[1] "The Corrosion and Fouling of Ships", *J. Inst. Naval Arch.* (April 1943).

Stripe Smut of Rye

AN increasing number of farmers now make a routine practice of dressing seed corn before sowing with a reliable organo-mercury seed dressing, for by this means the following diseases are prevented bunt of wheat (*Tilletia caries*), covered smut o barley (*Ustilago Hordei*), leaf stripe of barley (*Helminthosporium gramineum*), net blotch of barley (*Helminthosporium teres*), covered smut of oat (*Ustilago Kolleri*), loose smut of oats (*Ustilag Avenæ*), and leaf spot (or stripe) of oats (*Helminthosporium Avenæ*).

Although wheat, barley and oats are so treated the majority of farmers do not appreciate the importance of using a similar dressing for their rye seed, and the manufacturers of these dressings although they recommend such a treatment, do no always specify a valid reason for its use.

It is of interest, therefore, to record that in Norfolk we have recently encountered cases of stripe smut of rye (*Urocystis occulta*), and on one farm som eighty acres were moderately affected. The disease is rare in Great Britain, for in the past twenty year the senior writer has not observed it in East Anglia, but there is a record of its appearance at Rothamsted in 1932, and Mr. W. C. Moore informs us that a small amount was found near Romsey, Hants, in May 1920, and at Askham Bryan, Yorks, in Augus 1936, on the rachis of one head in experimental plots. The disease is seed-borne and is known to be amenable to the same treatment as for bunt in wheat it can, however, be contracted from the soil. As th acreage now under rye has increased, it is suggeste that plant pathologists would be well advised t advocate the treatment of rye seed before sowing as a preventive measure against this (and other) disease and, where cases are encountered, to dissuade farmer from taking another rye crop in succession o the same field. We are indebted to Mr. R. Line for first bringing this disease to their notice.

W. A. R. Dillon Weston.
R. Eric Taylor.
School of Agriculture,
Cambridge.
July 13.

Sharp Eyespot of Wheat caused by *Corticium (Rhizoctonia) Solani*

Eyespot of wheat caused by *Cercosporella herpotrichoides* is widespread in East Anglia, where it causes considerable loss in yield[1]. Typical symptoms of the disease are oval brown-bordered lesions on the straws near soil level. Similar, but less regular, lesions caused by another fungus have been recognized at Rothamsted as a different disease since 1935. This was described in Holland and figured by Oort[2], who called it sharp eyespot but did not identify the causal organism. Sprague[3,4] found a Rhizoctonia causing similar symptoms on wheat in Oregon. Blair[5], working with *Rhizoctonia Solani*, found that some Canadian strains when inoculated into wheat caused a stem girdling injury the photographs of which resemble those of sharp eyespot. Neither worker identified the lesions caused by Rhizoctonia as the sharp eyespot described by Oort.

We have obtained wheat plants with sharp eyespot resembling those figured by Oort, Sprague and Blair from many localities in England and Wales, and have consistently isolated from them a fungus of the Rhizoctonia type. We have inoculated wheat seedlings with six isolates from four districts; all produced sharp eyespot lesions, from which we re-isolated the fungus. The six isolates have now been identified by Dr. Bisby, Imperial Bureau of Mycology, as strains of *Corticium (Rhizoctonia) Solani*.

The symptoms of sharp eyespot are rather like those of true eyespot, and care must be taken to distinguish between them. Sharp eyespot lesions tend to be more superficial than those of eyespot and are sometimes confined to the outer sheaths, though they may penetrate the straw; they often run up the stem to a height of several inches. Sharp eyespot has asymmetric lesions with sharply defined borders surrounding pale areas on which develop spreading patches of mycelium. This is at first light-coloured but later darkens to brown or purple. True eyespot differs in having regular oval lesions, generally within two inches of soil level; they have less sharply defined borders, with black spots of mycelium concentrated in the middle of the lesions.

Although sharp eyespot has been found in many wheat fields in England and Wales and one heavily infected crop has been reported, it is seldom present in more than about 1 per cent of the straws. It does not increase with the frequency of wheat or barley in the rotations as does eyespot, which may infect as many as 80–90 per cent of the straws where wheat and barley have been grown often. In the first wheat crop after grass, eyespot is generally absent or rare, but sharp eyespot is found just as commonly as on old arable land.

Mary D. Glynne.
Wendy M. Ritchie.
Rothamsted Experimental Station,
Harpenden, Herts. July 13.

Glynne, Mary D., *Ann. Appl. Biol.*, **29**, 254 (1942).
Oort, A. J. P., *Tidsch. over Plantenziekten.*, **42**, 179 (1936).
Sprague, R., *Phytopath.*, **24**, 946 (1934).
Sprague, R., *Phytopath.*, **27**, 798 (1937).
Blair, I. D., *Canad. J. Res.*, C, **20**, 174 (1942).

Petal-Colour Inheritance in Lychnis

Investigations of petal-colour inheritance in Lychnis species have resulted in considerable confusion owing to insufficiently precise identification of the forms studied.

Numerous authors, from Bartram[1] (1699–1777) to Winge[2], have found the production of petal-anthocyanin to be dominant in crosses between the closely related *L. alba* Mill. (*L. vespertina* Sibth.), with white petals, and *L. dioica* L. em Mill., with reddish-purple petals (Shull reunites both under the latter name). By crossings in reciprocal directions I have fully confirmed this. In a back-cross between the F_1 and *L. alba*, segregation took place in the ratio of one plant with coloured petals to one with white petals.

Only Shull[3] differs from this belief, postulating that the production of colour depends upon the action of two dominant genes, each of which can be carried latent in white-petalled individuals. No other author has confirmed this and so far as I am aware Shull has not repeated it.

The existence in Nature of individuals resembling *L. alba* but possessing coloured petals (*L. alba* var. *colorata* Lange) might be advanced as support for Shull's theory, but several authors have noticed that these individuals are absent from areas from which *L. dioica* is also absent. Post[4] does not mention them from Palestine and Sinaii, where *L. dioica* does not occur. I have investigated many individuals of this kind (in several cases in swarms) and circumstantial evidence from the localities, together with positive evidence from pollen-sterility counts, measurement of certain vegetative and floral parts and comparison with hybrids (raised in the experimental plot from artificial crosses) as well as herbarium material has convinced me that they are either hybrids between *L. alba* and *L. dioica* or descendants therefrom.

In both *L. alba* and *L. dioica* the production of anthocyanin in the vegetative epidermis and the calyx (especially of staminate plants) is marked. Experiment has shown that it may be caused to develop even further by increased insolation, waterlogging of the soil, etc. Such increase is reflected in greater depth of petal coloration in *L. dioica* as the plants are transferred from shade to full exposure and vice-versa.

Although the petal-colour of the F_1 hybrid is less intense than that of *L. dioica* when the progeny is grown under the same conditions as the parent, variation of these may upset its manifestation. The matter is further complicated by the accompaniment of anthoxanthin, which certainly acts as a co-pigment to the anthocyanin, causing a blueing of the reddish-purple colour of *L. dioica*. It is present to a greater extent in *L. alba* than *L. dioica*, as might be expected on the basis of Lawrence and Scott-Moncrieff's[5] theory of the common precursor and balance of anthocyanin and anthoxanthin. These factors are probably partly responsible for the great range of colour shown by F_2 generations.

After frost or rain and as the season progresses, the shade of the coloured petals becomes increasingly blue. These facts probably dispose of Shull's factors for "reddish-purple" and "bluish-purple".

A variety of *L. dioica* is known (*L.d.* var. *albiflora* Tin.) with white petals. Examination of this form from several sources, combined with herbarium investigations at the Royal Botanic Gardens (Kew), the University of Cambridge, the British Museum

(Natural History) and the South London Botanical Institute (to the authorities of which I am very grateful) have shown that this variety contains no anthocyanin anywhere in the plant under normal conditions. My measurements show that the specimens are not hybrid segregates with white petals, although they have occurred in widely separated localities where natural hybridization has been present. It is possible that this process has been a stimulus to mutation.

A cross has been made by pollinating this form with pollen from normal *L. dioica*, which gave equal numbers of plants with anthocyanin in both vegetative portions and petals and plants containing no anthocyanin whatever. This may be explained by the assumption that inhibition of anthocyanin production is due to the action of a dominant gene, and that the white-petalled parent was heterozygous in this respect (as would be expected in a plant from Nature). The inhibition causes the production of white petals, even though the plant may carry the gene which produces petal colour, in the absence of the dominant modifying gene. The inhibition is not quite complete, for the partially unfolded petals have a faint salmon-pink colour, which reappears as the petals fade. When fully open the petals have a tantalizing "near-pinkness". The petals of *L. alba* often develop colour on fading, but this is blotchy and bluish.

The growth of a plant of the var. *albiflora* in artificially water-logged soil in full insolation has shown that anthocyanin is produced in the stem, but in very much less quantity than in normal *L. dioica* under similar conditions. Modification of inhibition is probably the cause of the pink petals developed by Harrison's[6] white-petalled variety after infestation with *Contarinia steinii*.

The presence of an analogous form in *L. alba* might be expected, and it is believed that it has been found in a group of four individuals found among many thousands of specimens growing in a field going fallow at Varndean, Brighton. That four individuals should occur so close together in a position where it is unlikely that more than two generations were present makes it probable that the inhibiting action is again due to a dominant gene. Flowers of this variety of *L. alba* do not show any blotches of colour when they fade.

The inhibition of anthocyanin production does not inhibit the production of anthoxanthin, the varieties described giving anthoxanthin reactions in approximately the same strength as *L. dioica* and *L. alba* respectively.

Lychnis coronaria normally possesses anthocyanin in both stem and petals, but a recessive white-petalled variety exists in cultivation which has anthocyanin in the stem in comparable quantity. This case is analogous with that of *L. alba*.

Further extensive pollinations have been performed, and with the results from these it is proposed to deal with the matter in detail elsewhere.

H. G. BAKER.

114 Evelyn Crescent,
Sunbury-on-Thames,
Middlesex.
June 20.

[1] Bartram, J. in Zirkle, C., "The Beginnings of Plant Hybridization", 148 (Philadelphia, 1935).
[2] Winge, Ö., *Hereditas*, **9**, 274 (1927).
[3] Shull, G. H., *Bot. Gaz.*, **54**, 120 (1912).
[4] Post, G. E., "The Flora of Palestine and Sinaii", vol. 1 (Oxford, 1932).
[5] Lawrence, W. J. C., and Scott-Moncrieff, R., *J. Genet.*, **30**, 155 (1935).
[6] Harrison, J. W. H., *Entom. Month. Mag.*, **78**, 231 (1942).

A Suggestion respecting the Bacteriostatic Metabolic Products of Moulds

IN view of the variability of many fungi and the possibility that moulds and bacteria may be mutually biologically antagonistic when growing in the same medium, it is perhaps not too fanciful to suppose that repeated culture of a mould and pathogenic bacteria together may develop increased production of bacteriostatic metabolic products of the former. Various forms of the assumed antagonism can be imagined, and competition for a common growth-factor is probably the simplest. Furthermore, provided such antagonism exists, it is easy to see that in still or viscous media the mycelial nuclei that contained cells producing the bacteriostatic substance would have the greater survival value.

I have no present opportunity to test this idea myself, but think it would be worth while to try to produce bacteriostatic substances against selected pathogens by repeated mixed cultures, using a variety of moulds for the purpose.

R. ROBINSON.

Dyson Perrins Laboratory,
Oxford.
July 17.

Sex Ratio Affected by Host Plant

THE cacao thrips *Selenothrips rubrocinctus* (Giard) is an important pest of cacao (*Theobroma cacao*) in the West Indies, West Africa and Brazil, and also attacks a number of other tropical plants, including mango, avocado, guava and cashew. It is a parthenogenetic species, although males occur rarely in the field. The males are very active and frequent copulation occurs, the sexes remaining *in copula* for from one to three minutes.

Urich[1] in Trinidad was the first to make observations on the male. Reyne[2] in Surinam found that the generation produced by mated females differed in no way from the normal parthenogenetic generation. Mating is apparently unsuccessful, and I have similarly been unable to obtain a sexual generation. I agree with Reyne's suggestion that the occurrence of males is apparently no longer of any importance to the species and is probably only a remnant of the former method of sexual reproduction. Reyne (*loc. cit.*) made counts in Surinam of 77 males and 29,100 females on cacao, the sex ratio being 1 male : 378 females and the percentage of males 0·26.

Large numbers of cacao thrips are required for experimental work in Trinidad, and they can be more readily obtained from cashew (*Anacardium occidentale*) than from cacao. The species of thrips occurring on cashew is undoubtedly the same as that found on cacao, but larger populations are as a rule encountered on the former host plant.

It was frequently observed in the field that male cacao thrips were more numerous on cashew than on cacao. Counts made in Trinidad in 1941 and 1942 gave the following results: on cacao 14 males and 9,728 females, the sex ratio being 1 male : 695 females and the percentage of males 0·14; on cashew 80 males and 3,440 females, the sex ratio being 1 male :

43 females and the percentage of males 2·33. Males were therefore more than sixteen times as numerous on cashew as on cacao.

The following, among other suggestions, might be put forward to explain these facts: (1) the production of a greater proportion of males with higher population densities; (2) the differential mortality of the sexes on the two host plants; (3) the physiological effect of the food; (4) the existence of distinct biological races on the two host plants; and (5) cashew, being supposedly more nearly allied to the original host plant than is cacao, supports a population more closely akin to the bisexual gamogenetic form hypothetically present on the ruderal host plant.

The significance of this phenomenon is unknown and no explanation is advanced. It would be interesting to know of any other examples among insects of the sex ratio being similarly affected by the host plant.

E. McC. CALLAN.

Entomology Department,
Imperial College of Tropical Agriculture,
Trinidad, B.W.I.

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[1] Urich, F. W., Circ. Board Agric., Trinidad, 6–7 (1911).

[2] Reyne, A., Bull. 44, Dept. Landb., Surinam, 50–52 (1921).

Reductone and Vitamin C

DR. F. WOKES and his colleagues have referred[1] to the chemical similarity of the reductones to vitamin C. The production of reductones by heating carbohydrates with alkali[2] is incorrectly attributed by them to Norrish and Griffiths, but it may be mentioned that the latter[3] obtained a high yield of reductone (hydroxypyruvic aldehyde) by irradiating glyoxal vapour with violet and near ultra-violet light.

Hydroxypyruvic aldehyde, a substance chemically akin to vitamin C and the carbohydrates, can be produced from inorganic sources by the following sequence of reactions:

$$(1)\ O_2 \xrightarrow[\text{light}]{\text{U.V.}} O_3;\ (2)\ O_3 + C_2H_2 + H_2O \rightarrow C_2H_2O_2 + HCO_2H;^{4}$$

$$(3)\ C_2H_2O_2 \xrightarrow[\text{light}]{\text{U.V.}} CO + CH_2OH.CO.CHO.$$

Such a short series of formally simple reactions may suggest the possibility that traces of reductone might be formed from the gases in the atmosphere without the intervention of a living organism, but this appears highly speculative.

J. G. A. GRIFFITHS.

London, N.14.
July 13.

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[1] Wokes *et al.*, NATURE, 152, 14 (1943).

[2] Dr. Wokes has kindly informed me that the reference should be to Euler and Martius, *Annalen*, 505, 73 (1933).

[3] Norrish and Griffiths, *J. Chem. Soc.*, 2829 (1928).

[4] Wohl and Bräunig, *Chem. Z.*, 44, 157 (1920).

Conception of the Tail in the Craniata

THE word 'tail' is used in the anatomy of the Craniata indiscriminately for two concepts: first, for the post-anal appendage, and secondly (especially in osteology) for the post-sacral region. While directing research on the anatomy of the Testudinata and other reptiles for many years past, I have often been struck by the unjustifiability and ambiguity of this usage and the confusion that results from it. Although in many vertebrates the two regions commonly denoted by the term 'tail' may appear to be more or less co-extensive, careful observation reveals that they scarcely ever correspond with each other to such an extent as to be regarded as identical. The anus seldom if ever lies precisely at the hinder level of the sacrum. In some cases (testudinates, crocodilians, etc.) it is a longitudinal slit and may extend beyond the limits of a single vertebral segment, its anterior rim usually lying distinctly posterior to the hind face of the sacral (or the last sacral) vertebra.

In the testudinates, perhaps, the condition is the most remarkable. While the sacro-iliac articulation lies craniad to the posterior border of the carapace considerably within the corselet, the anus occupies a position always outside the shell when the 'tail' is fully extended. Such a position of the anus, markedly posterior to the hind face of the sacrum, is apparently correlated with the functional necessity of discharging the fæces beyond the corselet margin. Thus the two regions commonly connoted by the word 'tail' are here very distinct, as the intermediate region between the sacro-iliac articulation and the anus is fully developed. The post-sacral part is always present although the post-anal region may be more or less atrophied in certain cases.

In view of this disparity in meaning, it may be best to restrict the word 'tail' uniformly to one concept, the post-anal appendage, and apply another word to the post-sacral region. For the latter a suitable term is already available, the 'coccyx' or 'coccygeal region', but its connotation has to be extended from the post-sacral region of the vertebral column to that of the body and it has to be scrupulously adopted to the exclusion of the word 'tail' whenever this region is meant. Thus the so-called 'caudal' vertebræ should be called the coccygeal vertebræ, the 'urostyle' (Gk. *oura*, tail; *stylos*, pillar) the os coccyx, and the loosely designated 'tail' of testudinates the coccyx or coccygeal region. The part of the coccyx between the sacrum and the anus, which is well developed in turtles, may be called the preano-coccyx in order to distinguish it from the post-anal part of the coccygeal region (postano-coccyx), which is equivalent to the tail, *sensu strictu*.

If we accept this nomenclature, the cyclostomes and fishes have a tail, but no coccyx differentiated at all, as the sacro-iliac articulation is lacking. In other words, they form a division of the Craniata which may be called Acoccygea. The coccyx is distinguished only when the sacro-iliac articulation makes its appearance, and this happens in the Tetrapoda, which may, therefore, be designated Coccygeata.

Among the Coccygeata, the amphibians and reptiles, as a rule, have the tail and the coccyx well differentiated, more or less corresponding with each other but never co-extensive. The difference in position between the anus and the sacro-iliac articulation, which is responsible for the variation in extent of these regions, is explicable on the basis of functional requirements, since the position of the vent always corresponds to the place behind the sacrum where the muscular movements connected with the pelvic musculature on one hand, and the caudal on the other, bound an area of little myogenic disturbance. This is essential, as otherwise the violent movements of the adjacent muscles might disturb proper defæcation.

In snakes the sacrum has been secondarily lost and thus the coccygeal region is not distinguished from the preceding part, although the tail is well defined.

In the Testudinata, the preano-coccyx contains an extension of the cœlom around the terminal part of the gut, a feature which is always absent in the tail, strictly defined.

Extant birds have a small coccygeal prolongation but no true tail, although some extinct forms (Archæopteryx, for example) had a fairly long tail. Mammals have both.

Developmentally, the vent, as is well known, marks the position of the blastopore, so that a true tail is strictly post-blastoporal in origin.

Beni Charan Mahendra.

Department of Zoology,
St. John's College,
Agra.
March 3.

Arapesh Maternity

The Arapesh are a people of an area of north-western New Guinea lying at and about 143° 30′ E., and 3° 30′ S. They have a custom of segregating women in outshelters at all times of the catamenia. Like most other women in this respect, Arapesh women do not ovulate or menstruate for an interval after parturition and during nursing. This organic quiescent period is usually known as the lactogenic interval. The Arapesh have the unusual custom that a woman and her husband must notice the advent of the first post-partum onset of menstruation in her body by giving a feast to the neighbours. The first post-partum onset of menstruation in a woman's body during lactation is termed in the Arapesh tongue *helib*. The feast given by a woman and her husband to the neighbours a few days after *helib* is termed in Arapesh *Kwa di batauin*. It takes place, on Arapesh evidence, between six to twenty-five months after child-births, as noted by the nursling having first cut its first two incisors (6–9 months) in some cases, and having first cut all its milk teeth (24 months) in other cases, with a modal time about the intermediate age of the nursling walking and talking.

There are said to be no Arapesh women who resume menstruation during nursing before the infant has cut its first incisors, although the clinical evidence indicates that some Caucasian women resume menstruation during nursing as early as one month after the birth of the child[1]. The Arapesh are an inbred group not more than eight thousand in number, and they may all be representative of a constitutional type with a comparatively long lactogenic interval. However, there is no known explanation of this point of difference. There are said to be some Arapesh women who do not resume menstruation during nursing until the infant has first cut all its milk teeth. The clinical evidence does not indicate that any Caucasian women have as long a lactogenic interval as this. However, the maximal time of the interval, stated to be not long over twenty-four months in the Arapesh population, is possibly not matched in the data available on the Caucasian population, because Caucasian populations usually wean infants before that time, and because early weaning may bring a lactogenic interval not already closed to a close. It may be noted that nursing for three years, which is common Arapesh practice, does not prolong a lactogenic interval for three years.

An assumption in respect to the conditions of a particular type of co-ordination of vital processes is not in the same field as a proof of the action of isolates or of near isolates in vital activities. The assumption that instances of a twenty-four months long lactogenic interval depend upon nursing being continued at least as long, and upon an individual constitutional factor, is not, for example, in the same field as a proof that a certain fraction, not isolated, obtained from the pituitary gland can initiate mammary secretion, and, in some species, stop ovulation[2]. Nevertheless, the assumption is reasonable.

The observation that nursing for three years will not prolong a lactogenic interval for three years is good against the chance, however remote or however proximate it may be, that prior resumption of sex relations after parturition may be an interfering factor provocative of renewed ovulation. The Arapesh do not resume familial sex relations after parturition until after *helib*.

The idea behind the Arapesh practices discussed here is evidently an idea of controlling population growth by abstinence during the lactogenic interval, adjusted to the exact length of time of the interval in individual cases. In previous accounts of Arapesh sociology[3] the idea in point has been distorted and the associated practices incorrectly described. The social 'culture' has been described as "working, selecting a maternal type as desirable, and embodying this choice in every thread of the social fabric"[4]. The Arapesh have, in fact, a predilection for maternal types. They believe, not without prejudice to some, that the constitutional types with the longest lactogenic interval make the best mothers. Nevertheless in matters of history and of social 'culture' the Arapesh still embody ideas in their social fabric. They do not attempt the impossible task, attributed to them, of embodying one constitutional type rather than another, instead of ideas there.

In an account of the associated practices the ceremonial feast at *helib*, namely, *Kwa di batauin*, has been omitted, and the resumption of familial sex relations after parturition has been dated about the time of the nursling walking and talking, without reference to the point that it occurs, in fact, at various times, but always a few days after *helib*.

R. F. Fortune.

University of Toronto.
May 25.

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[1] Hoskins, R. G., "Endocrinology", p. 294 (W. W. Norton and Co., 1941).

[2] Riddle, Oscar, "Prolactin, a Product of the Anterior Pituitary and the Part it Plays in Vital Processes", Carnegie Institution of Washington, Supplementary Publications, No. 40 (1938). Cameron, A. T., "Recent Advances in Endocrinology" (London: J. and A. Churchill, Ltd., 1940), pp. 388–91.

[3] Mead, Margaret, "Sex and Temperament in Three Primitive Societies" (London: Routledge, 1935). "The Mountain Arapesh", Anthropological Papers of the American Museum of Natural History, 37, Pt. 3 (1940).

[4] Fortes, M., "Review of Sex and Temperament in Three Primitive Societies in Man", pp. 125–26 (July 1936).

AGRICULTURAL EDUCATION ASSOCIATION

SUMMER CONFERENCE

AT the summer conference of the Agricultural Education Association held at the University of Reading on July 8 and 9, the chief topic for discussion was the Report of the Luxmoore Committee on Post-War Agricultural Education. Lord Justice Luxmoore himself was to have been the guest of honour at the conference dinner on Thursday evening, but was prevented from attending by ill-health. Mr. W. J. Cumber, who proposed the toast of the Agricultural Education Association in Lord Justice Luxmoore's place, said that science has yet a lot to teach the agriculturalist, and he himself, in going to the institutes, colleges and universities with the Committee, had learned a great many things which were going to be of advantage to him. He believed in mixing up science with practice, for in that way only would it be possible for British agriculture to compete with the rest of the world.

Three sessions were devoted to discussing the Luxmoore Report, and to facilitate the deliberations a memorandum had been circulated to members asking specific questions. The first question, for example, was: Does the Association agree that *compulsory* continuation classes should be under the Board of Education ? With practically no discussion, members agreed.

The second point was, Should the national authority for voluntary agricultural education be a New National Council; the Ministry of Agriculture with appropriate technical staff; or the Board of Education ? There was some difference of opinion on these alternatives, though the last authority did not find a supporter. Regret was expressed that the Committee, in considering the re-organization of agricultural education, had not studied the system operating for many years in the United States. Some members thought that the relationship between the Minister of Agriculture and the proposed new national council had not been made sufficiently clear, while others feared that the report envisaged a system of autocratic, centrally-governed education. Others, however, felt that under the proposed central council some of the financial difficulties of the poorer counties might be solved, while at the same time the agricultural education service as a whole would be given a professional status. Eventually it was unanimously agreed that it should be the statutory duty of a competent central body to ensure that adequate agricultural education is provided throughout Great Britain; by a five to one majority, the proposed new National Council was approved as the national authority for voluntary agricultural education.

There was an interesting debate about the desirability of local advisory committees having executive powers, the general feeling being that it would not be possible to get together or hold together the best men on committees that are purely advisory. The desirability of each county initiating the scheme of education best suited to it, rather than having a central scheme forced upon it, was also stressed, and the meeting passed a resolution that the National Council should work through new committees with executive powers to initiate and carry out approved schemes of agricultural education.

With regard to the specialist advisory service, it was suggested that certain of the science subjects, such as mycology and entomology, are not of sufficient economic importance to justify specialist advisers, and that there should be provision for advisory officers in the broader subjects such as botany, grassland, animal husbandry and plant husbandry. American experience was quoted on this matter, and after further debate it was agreed that the present classification by sciences is unsatisfactory and inadequate, and that attention be directed to the need for re-grouping in order to cover the whole field of agriculture.

The conference was unanimous in deploring the proposed separation of the teaching and advisory services, which would seriously impair the efficiency and usefulness of both, and it did not agree with the drastic reduction in the number of provinces recommended in the Luxmoore Report. It also concluded that the unification of the advisory work of the county organizer and that of the specialist provincial advisers would not be easily secured under a provincial administrator, and it re-affirmed the principle laid down in the evidence submitted by the Association to the Luxmoore Committee, namely, that "it is the opinion of the Association that for the efficiency of advisory work all local organizers and specialist advisory officers should be members of one organisation, but this opinion is expressed without prejudice to the opinions held by members about the best administrative means of effecting such unification".

The conference then proceeded to discuss in detail the proposals of the Luxmoore Committee regarding farm institutes, agricultural colleges and university departments of agriculture, taking the paragraphs as set out in the Report. Many of these paragraphs were accepted without debate, but on others there was a useful exchange of opinions which considerations of space make it impossible to report adequately. A fuller account will appear in the Association's journal *Agricultural Progress*. It is interesting to note, however, that there was general condemnation of the national diploma in agriculture.

During the three sessions, the conference was very greatly helped by the contributions of Mr. R. Ede, secretary of the Luxmoore Committee, whose explanations and general assistance were much appreciated by members of the Association.

Turning now to the formal papers, there were two of outstanding educational interest. The first was a description of the progress of grassland research in the United States by Prof. D. B. Johnstone-Wallace, who has returned to Great Britain on special leave after fourteen years as agrostologist and professor at Cornell University. Grassland research in the United States is a comparatively recent development; Prof. Johnstone-Wallace found that there was very little work being done on pasture improvement when he made his first tours in the eastern States during 1929 and 1930. Since then, the importance of phosphorus and nitrogen have been recognized, and the high value of wild white clover has been amply demonstrated. Detailed examination of strains of herbage plants from all parts of the world have been carried out, and it has been found that Kentucky blue grass (*Poa pratensis*), creeping red fescue, and certain types of timothy and cocksfoot, together with wild white clover, are the most useful species for general use. Much is expected from bird's foot trefoil, which has been found to possess drought-resisting properties of a high order. For silage purposes a combination of Ladino clover (a giant species of white clover) and

Aberystwyth "mop" cocksfoot has given exceptionally good results.

An interesting development in the pasture work at Cornell is the detailed examination of the movements of grazing animals, during which the actions of beef cows are accurately recorded throughout complete periods of 24 hours. It had been found that a cow grazes only 8 hours daily, lies down 12 hours, 'stands about' 4 hours, and chews the cud 7 hours. It walks about 2½ miles a day, drinks water only once, and grazes to within half an inch of the ground surface. It prefers herbage that is four to five inches long, and if the grass grows longer than this its consumption falls off. Altogether, this piece of research provides a remarkable confirmation of the value of rotational grazing.

The second paper dealt with the organization of agricultural education in the United States, and was given by Prof. R. Rae, of the University of Reading, who recently made a tour of the principal agricultural colleges in America. In general, the American system resembles that in Britain, for the activities of each centre fall into three main sections, teaching, experiment or research, and extension service. Prof. Rae, however, was very favourably impressed with the way in which all the various agricultural services, both State and Federal, are grouped together in the same town, and he believes that Great Britain might well give serious consideration to this point when considering post-war organization. Equipment for teaching purposes is on a much larger and more generous scale than we have ever aspired to; some of the examples quoted by Prof. Rae left no doubt in the minds of his audience on this point.

Extension work was described as "the educational arm of agriculture in the United States. It is a co-operative project between Federal, State and local governments, and private groups of farmers and people. . . . It has a large number of local unpaid volunteer leaders consisting of farmers and farmers' wives, and a relatively small paid staff". These extension services combine in America the fields of work covered in Great Britain by the advisory service and the county agricultural staff. From Prof. Rae's paper, however, one got the impression that it goes further than the British system; for example, there are more than a million volunteer neighbourhood extension leaders organized into a system whereby, the Government can reach every farm family with important information on measures necessary in connexion with the War, while "through doing, and leading others, the rural man, woman or youth who takes part in extension work experiences a change in his or her person. This change is one that builds ability and greater confidence in self and future".

PEOPLES OF NEW GUINEA

THE ninth of the Smithsonian War Background Studies series deals with New Guinea*, that fascinating island which lies to the north of Australia and has been so much in the public eye since Japan entered the War. With its central backbone of high mountains and its coastal areas of swamp or coral reef, it is an island of great contrasts, while the discovery of gold in the interior proved a notabl addition to the valuable traffic in bird of paradis plumes—now forbidden. The island is divided int three portions, the westerly administered by th Netherlands, the south-east by Australia and th north-east, formerly German, also by Australia unde a mandate. Owing to the difficulty of travel, whic was done for the most part by rivers, the interio remained only partially explored until recently when air transport to the goldfields opened up a great deal of the interior.

The natives are of three main stocks, the Negritos in the northern mountains, the Papuans and the immigrants from Melanesia; there has, naturally been a lot of inter-marrying, but the three groups are easily distinguishable. The Negritos are a small woolly-haired people found at certain spots along the central range, living still in the stone age, and with bows and arrows and a deadly stone axe as weapons They are on the whole a friendly and cheerful people and presumably the earliest human inhabitants. The Papuans, who also arrived in the island at an early date, are the characteristic racial stock and are a bigger race than the Negritos; they are dark-skinned woolly-haired and inclined to be bearded. They occupy most of the interior of the island and all the west and south-western coastal region from Geelvink bay to the Gulf of Papua, as well as other scattered areas. Although they practise a certain amount of simple cultivation, they are more typically hunting and fishing folk with a strong tendency towards cannibalism, headhunting and fighting in general. The Melanesians—the latest arrivals—are found around the east, north-east and south-east coasts and are a lighter-skinned race with hair that may be frizzy or wavy. (The author's statement that they are dark-skinned and woolly-haired does not tally with the descriptions by Seligman and other authorities.) They are a sea-going folk with fine outrigger or double canoes and are of a more cheerful disposition than the often morose Papuans.

It is a pity that some photographs of these attractive people and their culture in the south-east could not have been included in this publication, instead of the illustrations being confined to Netherlands New Guinea.

K. RISHBETH.

EDUCATION IN THE ARMY

DURING the winter of 1942-43 Dr. S. J. Curtis acted as chief instructor at the various courses of army education held at the University of Leeds. The courses were designed to be of assistance to regimental instructors who, on returning to their units, were invited to lecture and introduce discussions and in other ways promote the growth of the war-time scheme for education in the Army. As the courses proceeded it was recognized that a useful purpose would be attained by providing the instructors with information about the institution to which they owed allegiance, the British Army. Most soldiers have some knowledge of their particular regiment, but many are unfamiliar with the regiment's place in the general background of the Army. Dr. Curtis' excellent little volume[1] has been prepared to meet the deficiency. The soldiers who read it will scarcely avoid feeling a legitimate pride as members of an organization whose proud record is still unfolding. "The Story of the British Army" should find its way to every unit library and would still reward the soldier who added it to his already over-weighted haversack.

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* Smithsonian Institution. War Background Studies, No. 9: The Native Peoples of New Guinea. By M. W. Stirling. (Publication 3726.) Pp. vi+25+28 plates. (Washington, D.C.: Smithsonian Institution, 1943.)

"Adult Education in H.M. Forces"[2] suggests that the book is mainly concerned with a description of the educational scheme which has been developed in all three Services. This is not so. It has been designed particularly for the use of regimental instructors. On the other hand, Major Phillips and Capt. Curtis are much too modest in stating that the book would be useful only for unit *education* instructors. It would be of considerable value to all men and women in H.M. Forces whose duty it is to train other men and women in the use of weapons, the principles of wireless, the precautions to take against gas attacks or any other duty which involves the use of the instructional method. This point is admirably summed up in the preface by Brigadier C. G. Maude, controller of the Army Educational Corps, in his remark that "it is now no longer enough for an instructor to 'know his stuff', he must be able to 'put it across' in a clear and interesting manner".

The introductory chapter contains a brief account of the development of education in the Army. For the instructor the well-written chapter on "How People Learn" should be of great value. Here the authors emphasize the point that the real aim of the instructor is to stimulate others to learn, and not merely to impart knowledge. This brings out the important point that instruction is an active process for both speaker and listener.

Other sections of the book deal with the manner in which a talk might be prepared, the use of visual aids and the methods of guiding discussions. One or two examples to illustrate teaching method are included as well as some useful hints on how to handle adult classes. The book will be warmly welcomed by many Service men and women who, for the first time, have been called upon to instruct others.

[1] "The Story of the British Army". By Dr. S. J. Curtis. Pp. 48. (Leeds: E. J. Arnold and Son, Ltd., 1943.) 1s. 6d. net.

[2] "Adult Education in H.M. Forces". By Major J. O. R. Phillips and Dr. S. J. Curtis. Pp. 68. (Leeds: E. J. Arnold & Son, Ltd., 1943.) 2s. net.

TESTING AND RATING AIR FILTERS

EQUIPMENT for securing data on the efficiencies of air filters is described in an article by O. C. Eliason (*Bell Lab. Rec.*, 21, No. 8; April, 1943). The laboratory test for measuring the capability of a filter consists in passing air containing a known concentration of a standard dust through the filter and measuring the amount of dust remaining in the air. The equipment includes a wind tunnel with a variable speed blower for controlling the volume of air, and there are pitot tubes and gauges for measuring the flow and the static pressure of the air in the tunnel.

A machine has been developed for feeding dust into the air stream in the tunnel at a constant rate. A chain carries the dust from a hopper and drops it into an aspirator tube, from which it is blown into the air stream of the wind tunnel. A moving arm in the hopper stirs the dust and also wipes across the chain to ensure that it carries a uniform load. A standard dust, consisting of a mixture of lamp-black, powdered charcoal, iron oxide and wood flour, was chosen after considerable experimentation. It contains those components of natural dust which are most likely to tax the ability of air filters where dust conditions are severe.

An air sampling instrument for use in the field or in the laboratory was developed as a relatively accurate and easy means of determining, by weight, the amount of dust in the atmosphere and at the same time, by a discoloration test, affording a visual indication of the amount and character of the dust. It consists of a cylindrical chamber with one end screened and provided with a pipe, equipped with a pitot tube for measuring air flow, which connects the chamber with the suction side of a blower. To obtain a sample of the dust in the air, a white filter paper is placed over the screen and air is drawn through it at a constant rate. The dust in the air is deposited on the paper and its amount is quantitatively the difference in the weight of the paper before and after the test. The visual indication is given by the discoloration of the white filter paper.

The air filter on test is installed in the end of the wind tunnel and the volume of air through it is adjusted to its rated value. The dust feeder is then started, the volume of air and the rate of dust feed being constant throughout the test. Samples for determining efficiency are taken during the first hour and at specified intervals thereafter. Efficiency of dust removal is expressed as a ratio of the dust removed compared with the dust in the air entering the filter.

From the weight of dust fed during the test and the volume of air delivered by the blower, the amount of dust in grams per cubic foot of air entering the filter can be calculated. The corresponding amount of dust in the air leaving the filter can be calculated from the weight of that collected on the filter paper and from the volume of air passed through the filter paper. The filter paper is weighed before and after test on a balance sensitive to a tenth of a milligram, in a room in which temperature and relative humidity are constant. When tests are to be made outside the laboratory on air filters installed in a ventilating system two samplers are used, one on the intake side of the filter and the other on the outlet side. The efficiency of the filter is calculated from the difference in the weight of dust collected on the two filter papers.

A NEW ORDER OF CRUSTACEA[*]

THE minute crustacean which is the subject of this paper is a very interesting discovery. *Derocheilocaris typicus* n.g., n.sp., was found on the intertidal beaches and is regarded by the authors, probably justifiably, as belonging to a new order, which they name Mystacocarida. Although obviously closely allied to the Copepoda, it differs fundamentally in certain respects and is highly specialized in some ways and very primitive in others. The body consists, as in the Copepoda, of sixteen somites, of which the last six are legless. The somite of the maxillipede (first thoracic somite) is completely separated from the head—a most unusual feature. The last six

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[*] Mystacocarida. A New Order of Crustacea from Intertidal Beaches in Massachusetts and Connecticut, by Robert W. Pennak and Donald J. Zinn. (Smithsonian Miscellaneous Collection. Vol. 103. No. 9. Smithsonian Institution, Washington, Publication 3704. 1943.)

somites are regarded as abdomen, but a comparison with Gurney's[1] diagram (p. 33, Figs. 22–23) of the segmentation of a copepod shows a more likely interpretation to be that the first three are thoracic, the corresponding legs being lost altogether. Thus the body would be divided into a head of five somites, thorax of eight, and abdomen of three. The four legs present are simple and leaf-like.

The mouth parts are relatively unspecialized and apparently function in straining food particles out of interstitial water of sandy beaches. There is a large labrum. On the antenna of the larval stages is a so-called "quasi-palp" which disappears in the adult. It is suggested by the authors that this may function (or at one time did function) as a clasping organ, and in that case that the fifth larval stage may be (or may have been) a functional male phase. It seems clear, however, that this "quasi-palp" is homologous with the masticatory process of the Branchiopod larva (see Gurney[2], p. 18, Fig. 5). Five larval stages were found, but not a complete series, and there are probably still younger forms. All have two pairs of antennæ, mandibles, labrum, second maxillæ and caudal rami, only the two last having the first maxillæ and maxillipedes, although all have the so-called postcephalosome (somite of the maxillipede) already formed. No males were seen.

A very strange feature is the presence of the genital opening on the first thoracic somite. If correct, this is a fundamental peculiarity. More evidence is required, especially the tracing of the gonoduct.

It is claimed that in Derocheilocaris we have the most primitive living crustacean yet discovered. In spite of its undoubtedly primitive features, however, and its unique peculiarities, its close relationship with the Copepoda and even further specialization, particularly shown in the greater reduction of the thoracic limbs, make this supposition untenable. It is hoped that further details of this most interesting animal will soon be available.

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[1] Gurney, R., "British Freshwater Copepoda", vol. 1. Ray Society (1931).

[2] Gurney, R., "Larvæ of Decapod Crustacea". Ray Society (1942).

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Assistant Horticultural Officers (2)—The Executive Officer, Essex Institute of Agriculture, Writtle, Chelmsford (August 14).

Lecturer in Physics (temporary)—The Acting Secretary of University Court, The University, Glasgow (August 15).

Lecturer in Physics—The Principal, College of Technology and Commerce, Leicester (August 16).

Principal of the Queen's Royal College (Secondary School for Boys), Trinidad—The Secretary (I.P.R./C.A.), Board of Education, Belgrave Square, London, S.W.1; residents in Scotland should apply to The Secretary, Scottish Education Department (Branch Office), 29 St. Andrew Square, Edinburgh (August 16).

Assistant Lecturer and Demonstrator in the Physiology Department—The Secretary, The University, Birmingham (August 18).

Lecturer in Chemistry in the Brighton Technical College—The Education Officer, 54 Old Steine, Brighton 1 (August 18).

Laboratory Steward in the Science Department of the Doncaster Grammar School—The Chief Education Officer, Education Offices, Doncaster (August 21).

Head of the Department of Industrial Administration—The Registrar, College of Technology, Manchester 1 (August 23).

Professor of Animal Husbandry (Hygiene and Dietetics)—The Secretary, Royal (Dick) Veterinary College, Edinburgh (August 31).

Power Station Superintendent—The Engineer and Manager, Brighton Electricity Undertaking, Electric House, Castle Square, Brighton 1 (endorsed 'Power Station Superintendent') (August 31).

Deputy Director of the Research Department at Loughborough—The Secretary, Institution of Production Engineers, Portman Square, London, W.1 (endorsed 'Deputy Director Research').

Supervisor in connexion with the National Milk Testin Scheme, and a Dairy Bacteriological Assistant, in the Universit of Bristol—The Chief Advisory Officer, Agricultural Advisory Offic 22 Berkeley Square, Bristol 8.

Assistant Master to teach Science (with an Engineering bia and Practical Mathematics in the Forest of Dean Mining an Technical School and East Dean Grammar School—The Secretar County Education Office, Shire Hall, Gloucester.

Lecturer in Education, Psychology, and Social Philosophy—The Clerk to the Governors, South-West Essex Technical College an School of Art, Forest Road, Walthamstow, London, E.17.

Assistant Master in the Day Junior Technical School to teac Technical Drawing and Engineering Science; a full-tim Lecturer in the Department of Mechanical Engineering (qualifie to teach up to Higher National Certificate standard); a full-tim Lecturer in the Department of Mechanical Engineering (work training, previous teaching experience, and a suitable Degree a essential); a full-time Lecturer in the Department of Electrica Engineering (qualified to teach Electrical Engineering to Degre standard for the Higher National Certificate); and a full-tim Lecturer in the Department of Mathematics—The Principa Borough Polytechnic, Borough Road, London, S.E.1.

REPORTS and other PUBLICATION

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

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EDUCATIONAL RECONSTRUCTION IN EUROPE

THE picture of German efforts to suppress every kind of knowledge which is likely to conflict with totalitarian theory, and of the systematic thoroughness with which attempts have been made to standardize thought, given in the report "Axis Oppression of Education"[*] gives some measure of the immensity of the task of education, or re-education, which has to be undertaken in the enemy-occupied countries when they have been liberated. The task of re-educating Germany itself is even greater, and is one of the most difficult problems involved in the building of a new world order. The soundness of the prediction of the American historian, Charles Beard, in April 1936, that if the Hitler regime continued for several years the German people would be a people almost totally ignorant of the outside world, has been established by all that has elapsed since then.

No plan for the reconstruction of Europe which side-tracks or ignores this issue can hope to have any permanent results. The report "Education and the United Nations"[†], which was issued in March by a Joint Commission of the London International Assembly and the Council for Education in World Citizenship, should effectively dispose of any attempt to disregard this problem, though one might have looked for more attention to it in the memorandum on policy towards Germany which has since been issued by a Post-war Policy Group of members of both Houses of Parliament, of which Sir John Wardlaw-Milne is chairman. The Commission referred to above included members from twelve countries, among them China, the United States and Fighting France, and had as chairman Prof. Gilbert Murray, himself president since 1928 of the International Committee on Intellectual Co-operation.

The report falls into three principal parts. The first, which draws considerably on "Axis Oppression of Education", describes the extent and importance of the destruction inflicted by the Nazis, together with the measures recommended for restitution. The second examines the prospects and principles of re-education in Germany; and the third deals with education as a foundation for the post-war system, and the reforms and expansion necessary to secure the general raising of educational standards without which the ideals of the Atlantic Charter will end in disappointment. A campaign for a real attack on the giant of ignorance, which is an essential step in the establishment of the Four Freedoms, is outlined with conviction and with imagination.

It may be admitted that the free peoples of the world have scarcely any real conception even yet of the enormity of the destruction that has been wrought and the crimes that have been perpetrated by the Nazi armies and their imitators from Italy and Japan, and the report may well give further publicity to an aspect of the problem which was discussed in these columns earlier in the year (NATURE, February 6, p. 147). The Commission argues cogently that the work of educational reconstruction must be a combined effort of all the United Nations, and one of their first tasks when hostilities have ceased. Its specific recommendations, including the appointment now of a United Nations Bureau for Educational Reconstruction to prepare and, so far as possible, put into operation the necessary plans for meeting those needs which are too great for any one nation to bear alone, deserve the urgent and careful consideration of all the Governments concerned.

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[*] Axis Oppression of Education. Report of the Inter-Allied Information Committee. (London: H.M. Stationery Office, 1943.) 3*d*. net.

[†] Education and the United Nations. Report of a Joint Commission of the London International Assembly and Council for Education in World Citizenship. Pp. 54. (London: Council for Education in World Citizenship, 1943.) 1*s*. net.

Unless the Nazi system is extirpated, and the traditional militarism dominant in Germany and its supporting elements are overthrown, there is no hope for a peaceful Europe. The Commission holds that the first essential condition of the re-education of Germany is that the whole Nazi organization should be destroyed, the power of the German army broken, justice meted out to the war criminals, the fullest restoration of stolen property made, and the reality of defeat manifested to all the German people, so that they learn that aggression does not pay and place upon their present leaders inescapable responsibility for the just fate that overtakes them. With this principle the Commission holds that no fundamental re-education of the German people is possible if they are placed in a position of permanent inferiority, and that the re-education of Germany and the moral and spiritual regeneration of her people are no less important than their physical disarmament.

Education is unquestionably one of the surest foundations of peace, and the Commission submits that for the advancement of education and the cultivation of a right attitude of mind in all countries, the United Nations should establish an International Organization for Education with wider representation and greater powers than the International Committee on Intellectual Co-operation. The social objectives of the Atlantic Charter can only be achieved by a general raising of educational standards. Such an advance itself must be a matter of international agreement and may involve financial assistance for some of the poorer States.

The proposals for an International Organization for Education, which should be one of the principal parts of any new international authority, are to be further detailed in a subsequent report. While, however, it is true generally that only in so far as the rising generation can be educated for world citizenship will it be possible to maintain the solidarity of the United Nations and ensure peace, before Germany can co-operate in any such enterprise the German people must first be re-educated, and there is much to support the view of the Commission that they must re-educate themselves. The conquering Powers can, it is true, do something to create the conditions in which the re-education of the mind and character of the German people is most likely to succeed, and for this purpose the Commission suggests that the Occupying Powers should exercise their control of education in Germany through a High Commissioner for Education, who should be chosen in advance an ready to start work immediately occupation begin His purpose should be to eradicate the Nazi ar militarist influences in education and to inspir facilitate and supervise measures by the Germa people for their own re-education. The occupatio should continue at least until the High Commission is satisfied that his work can be taken over by t Germans.

The report makes no attempt to conceal t difficulties of any such proposal. The High Con missioner should be assisted by a Commission draw from Allied and neutral countries, which woul conduct a thorough examination of the who educational system in Germany and recommend wh further measures should be taken to eradicate Na and militarist teaching, and provide that gener framework of education in which the ideals of t Atlantic Charter are more likely to find suppor There is no reason to assume that all teachers professors who have retained their posts under Na rule are in sympathy with Nazi ideas, and it will important to discover as many men and women possible in Germany who are willing to assist eith as teachers or in other ways. While there must no reluctance to issue orders for the removal appointment of educational authorities, the dismiss of teachers, or the suppression of certain school-boo when necessary, it is essential to foster in every wa the foundation of properly constituted German educa tional authorities and organizations of teachers wh desire to give to education in Germany a huma and international purpose.

There are many detailed proposals outlined in t report which deserve attention. Some, like t suggestion that it might be worth while for Germa exiles during the War to prepare new text-books though these would obviously require careful e amination before their adoption for use in German —could be given immediate effect. Others, such the recommendation that the High Commission should ensure the removal from the universities all who gave active support to the Nazis or racialism in any form before 1933, or who have he high office under the Nazis such as rectors or *Dozen enführer*, and of all professors of *Rassenbiologie* an such bogus sciences, must wait until the occupation Germany begins. For others again, such as t substitution of some other form of organized yout activity for the Hitler *Jugend*, which must be di banded, and the supervision of the organized leisu activities of German youth, for which the Hig Commissioner would be responsible, the constructi thinking that is the first step should be proceedi already if the tentative lines of policy and action a to be prepared in time.

Mr. R. A. Butler, in an address to the Foreig Press Association, has given some support to the views. Urging that the process of re-education mu be the recognition by the enemy that war does n pay, he pointed out that the liberation of the Germa mind could only come about by an internal proces possibly a slow process, and as a result of ove whelming military defeat. It is essential, howeve that no great nation should stay outside any international machinery set up for education or any other purpose, and as Prof. E. H. Carr has remarked, we must give the German people not only a common interest in the building of the new Europe but also the sense of a common moral purpose, and in that sense re-education of Germany is only possible if we are prepared in the course of this process to re-educate ourselves.

For this reason it is encouraging to find recognition of this truth in a thoughtful study "Relations with Europe" issued by the editors of the American periodical *Fortune*. A section of this report devoted to the special problem of Germany recognizes the critical importance of education and its control; it urges the establishment of a European Education Office among its other proposals designed to degrade the Nazi regime, to establish the individual rights of every German to life, liberty and happiness—in contrast with the serious disabilities under which the German nation must be for years. Another point made is the need for the international administration to discover and train anti-Nazi Germans who show an instinct for leadership. Mr. Butler indicated that plans were already being made to repair the devastation of the educational system of Europe caused by Nazi methods based on the rejection of truth. In collaboration with the British Council, the needs of schools and colleges which will have to be restarted in the occupied countries would be dealt with first, particularly the provision of equipment and the discovery and training of prospective teachers. This matter is, of course, also being studied by the British Association Committee on Post-War University Education (see NATURE, December 19, 1942).

In the last resort, the possibilities of re-education in Germany and the nature of that re-education depend upon issues far outside the scope of the report on "Education and the United Nations" referred to above. The absolute power of the United Nations will give them a decisive influence on the development of internal conditions in Germany, and upon the policy they pursue towards Germany will depend the possibility of there emerging a new German State, with such social and economic conditions as will enable it to provide for all its people, without distinction of class or creed, a fuller and happier life of peaceful development and service to the community than they have ever before known. We can expect the German people to re-educate themselves as good citizens of Germany and of the world community only when they have grounds to hope for such a future—and, it might be added, the refugees from Germany will participate in this work only on those conditions.

It would, indeed, be unreasonable to expect refugees to participate unconditionally, and each additional year of war may well make their contribution more difficult. There is, therefore, all the more reason for neglecting no steps which can be taken to lay the educational foundations of the post-war system. The attempt to fit men for a better society must not be delayed while we are striving to create such a society. The restoration, protection and advancement of education must be regarded as a major task in settling the affairs of the world after the War. Unless some great purpose beyond the winning of the War animates the hearts and minds of men in all the United Nations, there is grave danger that once the urgent tasks of reconstruction have been completed, all our plans for destroying the power of our enemies to wage aggressive war and for the re-education of their people may come to nought, and the world once more may drift to war.

In this section of the report there are several suggestions for the extension of educational facilities, and particularly education in the principles of world citizenship. Methods for ensuring for all teachers a period of training in which they will make closer contacts with the lives of other people and gain a wider experience of life; raising the status of teachers to that of other great professions; a new emphasis in the teaching of all subjects; further participation by the universities in the work of adult education; the fullest co-operation between learned societies; the development of the Nansen pioneer camp: these are among many suggestions too numerous to be enumerated. The Commission proposes to examine more fully at a later stage various proposals regarding the universities, but it emphasizes the desirability of students of arts and theology receiving some introduction to the elements of scientific knowledge and some training in scientific methods of thinking, and of students of natural science receiving a similar introduction to philosophy and the social sciences. It is further urged that the present need and possibility of establishing in Great Britain an international institution of university character for research and teaching in all subjects related to international affairs, and for the provision of popular extension courses in those subjects, should be fully considered by the appropriate bodies.

Among the numerous practical suggestions of this valuable report are some that might well receive immediate attention, particularly in relation to the enemy-occupied countries. The Commission has been particularly impressed, for example, by the way in which the representatives from Greece are prepared to tackle the problems of reconstruction in their own country after the War, and there appears to be no reason why investigations of the possibility of founding in Egypt or in Great Britain during the War a training college for young Greeks aspiring to return to their native land as teachers, or to arrange special courses for them, under their own instructors, at some British training college or university training department, as recommended in the report, should not now be instituted. Moreover, as the Commission indicates, serious research is likely to be possible only in Western and Northern Europe for some years to come, and it is therefore the more imperative that plans should be ready for preventing, if possible, the theft of educational and research endowments, or for speedy restoration, and for dealing with the problems which may be created by changing economic conditions.

Many of the proposals of the report, and indeed all plans for educational reconstruction, involve political questions which will require the most careful examination. The failure of the Nazi attempts at re-educating the occupied countries is a warning as to the seriousness of the political problem and difficulties, and prophecy as to how wide the response of German youth to any such attempt at re-education or how many Germans are to be found, as Mr. Henry A. Wallace suggested, steeped in the German liberal tradition and the ideals of Scandinavian co-operation, to whom the task could be entrusted, would be extremely rash.

Educational reconstruction must form the basis of our plans for final reconstruction in Europe, but it must be linked with our political policy; and the two must be determined not in isolation but with regard to their reactions one on the other. On that relation depends very largely the answer to the question "Can We Win the Peace ?" Dr. Einzig's recent book of that title*, like the memorandum of the Post-war Policy Group, makes it clear how fundamental and important are the decisions as to our attitude to Germany which must be taken before any consistent policy can be framed. The points which the latter memorandum suggests for inclusion in the peace terms, for example, cannot well be considered apart from their effect on the probable attitude of Germany to the final post-war settlement. This applies particularly to such political matters as the proposal for breaking up Germany. As a contribution to lucid thinking about the fundamental issues, Dr. Einzig's book deserves attention, unpalatable as many may find his conclusions. On one indeed there can be no disagreement: the complete and unilateral disarmament of Germany is fundamental to winning the peace, and his suggestions on German trade and production after the War are designed to supplement that disarmament by making it impossible for Germany to regain her economic hold of the Balkans and other countries, while at the same time offering her people the prospect of a high standard of living if they co-operate in the new European system. Incidentally, he proposes to relate this latter prospect to the duration of the War and the continuance of their support of Nazism—a weapon of political warfare the effectiveness of which should not be missed.

There can be no question as to the complexity of the issues involved, but while on many matters of detail, particularly in regard to the re-education of Germany, further inquiry is still necessary, decision and action rather than inquiry are the primary need. Both must, it is true, follow on a careful weighing of the whole situation, but the consequences which may follow from a mistake in policy and in action must be no excuse for indecision. We must make up our minds as to the possibility and desirability of attempting the re-education of Germany and the practicability of holding down a disarmed and resentful Germany over a period of decades. Having made that decision, we must formulate the policy which will secure the conditions giving it the best prospects of success.

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* Can We Win the Peace? By Paul Einzig. Pp. x+148. (London: Macmillan and Co., Ltd., 1942.) 8*s*. 6*d*. net.

DYNAMICS IN PSYCHOLOGY

Dynamics in Psychology
By Wolfgang Koehler. Pp. 120. (London: Faber and Faber, Ltd., 1942.) 8*s*. 6*d*. net.

IT is good to meet a book of this quality in days when the non-academic world is measuring the value of science too exclusively by its immediate practical applications. If this attitude were to prevail indefinitely the future of science would be dark, and the prospects of the applied sciences themselves clouded. Psychology to-day is enjoying an unexpected and dangerous popularity because it has been found useful in application. Mental testing, industrial psychology, psychotherapy, these are the fields in which psychologists are considered to justify themselves. We are entitled to feel satisfaction that we have made some contribution to current problems; but it is necessary to insist that their scientific interest is soon exhausted, and that further developments in the sphere of practice are dependent upon the construction of a coherent body of theory. Prof. Koehler's book is very remote from a warring world, but because it deals with fundamental issues it may be regarded as ultimately of greater importance than the technical successes by which psychology is now at length securing a place in the sun.

This book contains no revolutionary addition to *Gestalt* theory, but it is of great value by reason of the new assembly of perceptual data adduced, and the hard and honest thinking which the writer brings to bear upon them. It may be commended as an introduction to *Gestalt* psychology, since the limitation of the problems dealt with brings out the more clearly the fundamental issues involved. Speaking very broadly, the author, who believes that scientific explanation means more than the colligation of facts, holds that psychological structures are causally dependent upon physiological processes, and that the latter are essentially electrodynamic in character. Thus it seems psychology is reduced to physiology, and that in turn to physics. If the facts are so we must accept them, but a reduction of this kind has some awkward situations to face. Do I know this book ? If so, that psychological experience is dependent upon electric fields in my cortex, and my knowledge of that explanation upon others, and so on in bewildering succession. We suggest that much more detailed knowledge of facts is required before resolute theorizing along this line is justified, and that we must exercise caution lest we mistake formal analogies for actual identity. Though they may be causally related, there remains a fundamental qualitative difference between the phenomenon called 'knowing' and its physiological correlate; and any form of epiphenomenalism has to meet the question of the origin of such an irrelevance as consciousness.

Having entered this *caveat*, we can pay tribute to the author's positive contributions. It is, we believe, inevitable that there should be an integration of the different sciences (though its achievement lies far ahead) and the methods and concepts of one science should be made to enrich others. Koehler is undoubtedly right in his insistence that psychologists should accept this principle and face the heavy task of acquainting themselves with other sciences, and his development of this theme in detailed examples is excellent. He takes obscure facts of visual perception, argues from their properties to the existence of electro-dynamic fields in the cortex (so indicating possible lines of research to the physiologist), then from the nature of the fields deduces the existence of other unsuspected visual phenomena, and empirically confirms his hypothesis by showing their existence. Incidentally, he gives a brilliant exposition of scientific method as a combination of hypothesis and factual observation. He claims with justice that his school has made the field-concept central in psychology. But field-concepts are unhappily difficult to handle. Probably we should do better to work with it for the present in the traditional spheres of psychology, avoiding attempts to construct theoretical relationships to other fields until field theories have become a real part of our intellectual furniture. We must note, too, the observations of Head and Lashley on the effects of ablation of cortical areas. These indicate that the organism must be regarded, not as a neutral region in which fields develop, but as a nodal and formative factor in its relations to the world. Gestalt psychology is still weakest on the functional side.

The latter part of the book takes up problems of memory, and is admittedly more tentative than the earlier. Koehler again applies the hypothesis of electro-dynamic fields, coupled with that of 'traces'. Here the physiology is thoroughly speculative, and the attempt is, in the reviewer's opinion, premature. The physiology necessary to explain remembering has still to be commenced, and so far as explanatory theory is concerned psychology is in little better case. But since the author makes no claim to deal comprehensively with memory it would be unjust to criticize the book for incompleteness. The chapters on perception offer sufficient material to the reader. The exposition is fully up to Koehler's high standards of lucidity, conciseness and firm thinking. He sets a model of careful yet bold argument, which those who challenge his conclusions would do well to imitate.

A. W. WOLTERS.

PRACTICAL AIR NAVIGATION

Astronomical Air Navigation

A Comprehensive Handbook embodying the Latest Principles for Practical Navigators, Instructors and Students. By Squadron-Leader Ronald Hadingham. Pp. xi+132. (Kingston Hill: The Technical Press, Ltd., 1943.) 10s. 6d. net.

MANY books on air navigation have been published since the beginning of the War. The essential feature of this volume is that it has been written for practical navigators by a practical navigator of great experience. It contains no mathematics, and the theoretical aspects of the subject are reduced to a minimum, though the fundamental basic principles are simply and clearly explained. Methods of working and reducing sights are fully described and special attention is given to practical work in the air.

The author's own experience has made him familiar not only with the difficulties that the beginner encounters but also with the precautions that must be taken by the practised navigator to obtain an accurate determination of his position. The arrangement and use of the Air Almanac and the Air Navigation Tables are fully dealt with, and fourteen specimen pages from the two publications are reproduced. A number of practical examples illustrate the methods and principles, and a description is given of the standard sextant used in the Royal Air Force and of the use of star curves. The volume can be strongly commended to the air navigator as being clear, concise, helpful and essentially practical.

It is unfortunate, however, that the chapter on astronomy—included to give the navigator a brief summary of facts about the sun, moon, planets and stars—was not revised by an expert. The author is here on less familiar ground, and many of the statements are inaccurate and misleading. After referring, for example, to the great distances of the stars, the comment is made: "Little wonder that distant starlight 'twinkles' unsteadily, while the closer planets shine boldly in contrast". The rings of Saturn are described as rings of vapour. Referring to the magnetic fields of sunspots, it is stated that "Sometimes the polarities are not balanced, however, as often occurs in the large very active groups, and it is under these conditions that we feel a magnetic influence on the Earth". It is also said that when the spot group crosses the central meridian of the sun, its lines of magnetic force fall on the earth.

It is to be hoped that these and some other errors will be corrected in a future edition, as also some eccentricities of English, such as the repeated use of *data* as a singular noun and the use of *focii* as the plural of focus.

H. SPENCER JONES.

INDUSTRIAL MYCOLOGY

An Introduction to Industrial Mycology

By George Smith. Second edition. Pp. xii+260. (London: Edward Arnold and Co., 1942.) 20s. net.

THIS is one of those useful books about one branch of science written for those who have specialized in another sphere of knowledge. Modern industrial chemistry accords an increasing allegiance to the natural laboratory facilities provided by several species of fungi. Citric acid now owes little but its name to citrus fruits, and is produced from sugar by a mould fungus, usually a species of Aspergillus. Gluconic acid, glycerol, fats, proteins, vitamins and antibacterial substances such as the newly discovered penicillin can now be added to the time-honoured production of alcohol as examples of mycological chemistry. Fungi can also interfere in a negative way with stored organic products.

Mr. Smith's book describes the principal fungi the activities of which are harnessed by chemists at the present time. Zygomycetes, Ascomycetes including the yeasts and related fungi, and Fungi Imperfecti are the main groups concerned, while separate chapters are devoted to Aspergillus, to Penicillium and its related genera, and to the Hyphomycetales. The classification is chiefly that of Saccardo, though several useful practical keys have been adapted from other authors. Descriptions of the species are quite adequate, and the use of fermentation tests or special methods to induce spore formation is frequently discussed. The illustrations, 136 in number, are a very attractive feature of the book. There are excellent half-tone blocks of photomicrographs taken at certain precise and selected magnifications, and are readily comparable one with another. The student is thus shown what he should actually see under the microscope provided his technique is adequate for this type of detailed study.

General mycologists will find considerable taxonomic interest, for many of the species considered in the book are little known outside the urge of necessity provided by industrial application, or the rare experience of a lexicophilic student of Saccardo or Rabenhorst. The teacher will also find it rich in material which can be used to provide that thrill in secondary education which is, alas, so often lacking. Mycology could surely be taught more interestingly through its human implications, and there must be few students too blasé to take delight in the mycological production of a soft lemon centre fit for the most expensive chocolate, or the quick production of a vitamin, or the mycelial short-circuiting of a synthesis laborious by all other methods.

The chapters on technique are detailed only in the methods which the mycologist superposes upon those of the bacteriologist. Preparation of slide cultures, for example, receives more minute treatment than routine sterilization. Physiology of the mould fungi is also dealt with in similar fashion, and an interesting short account of the mutual interaction of two species of fungi raises some potent questions in fungal ecology. The maintenance of culture collections and the control of mould growth are two further important industrial features dealt with in the volume. Perhaps the least satisfactory section is that on the industrial uses of fungi, but this is in no way the fault of the author. It is probable that few branches of knowledge are more concealed from the scientific world by the vested interests of patents than this small section of mould mycology.

Industrial mycology is an expanding science, and this volume will doubtless expand *pari passu*, for it provides an excellent basis. For a work of reference it is easy to read, and the reader is led beyond the immediate horizon by good lists of references, and a section upon mycological literature. This includes descriptions of general works, monographs, books on systematic mycology and on applied mycology, journals and periodicals. The volume is a very welcome and pleasing exposition of a little-known subject. J. GRAINGER.

EARLY BRITAIN

Britain B.C.

By S. E. Winbolt. (Pelican Books, A.106.) Pp. 160. (Harmondsworth and New York: Penguin Books, Ltd., 1943.) 9*d.* net.

THE writing of a really satisfactory elementary and popular book on the prehistory of Britain in some 150 pages is not an easy task. The author must have read everything himself and yet must not put in too much. The temptation to include details which are out of place in a small work is almost irresistible. Again, he must make up his mind whether or not to assume any previous knowledge of general prehistory on the part of the reader. If he does not, much of the small space at his disposal will have to be occupied with matter not exactly relevant to the immediate subject in hand. On the other hand, if he assumes a knowledge of prehistory and then merely details the more important discoveries made in Great Britain, he lays himself open to the criticism that he has merely produced a dull catalogue; yet such method of approach *can* produce a volume very useful both to the student and the holiday maker.

In the present book, little or no such general knowledge is assumed, and as a result there is rather a lack of balance. The stresses, too, do not perhaps always leave the right impression on the uninitiated reader; special finds such as those of decapitated skeletons are worthy of notice, but their occurrence does not necessarily mean that there was an epoch when mankind universally practised this custom (p. 97). The short book-list, too, presents anomalies. Parkyn's book is long out of print, but Baldwin Brown's work is not mentioned. Neither Childe nor Wheeler, who have both written volumes on parts of Britain, are mentioned. There are plenty of elementary first-rate English text-books on prehistory generally, so why cite Peyrony's "Éléments de Préhistoire". Finally, when describing a site or a find, surely it would be well to quote the opinion of the author who has made the matter his chief study, rather than the casual opinions of other writers.

But in spite of these criticisms, Mr. Winbolt has made a great effort to include a lot of facts in the compass of a small volume, and there will be many people who will find his little work an introduction to a fascinating hobby-subject which can well be studied in Britain. M. C. BURKITT.

ADVANCED ORGANIC CHEMISTRY

A Text-Book of Organic Chemistry

By the late Dr. Julius Schmidt. English edition by Dr. H. Gordon Rule. Fourth edition, revised and extended. Pp. xxvii+923. (London and Edinburgh: Gurney and Jackson, 1943.) 28*s.* net.

THE late Dr. Julius Schmidt's "Kurzes Lehrbuch der organischen Chemie" had established a considerable reputation as a text-book for students of advanced organic chemistry before Dr. H. Gordon Rule translated it into English in 1926. In this edition Dr. Rule acted as editor as well as translator, and in the later English editions of 1932 and 1936 his editorial role became more and more pronounced. He spared no pains to keep the work up to date, to preserve a proper balance between various sections of the subject, and to do justice to the work of British and American organic chemists.

In the fourth English edition these fundamental aims are worthily maintained. There will be widespread regret among organic chemists that Dr. Rule did not live to see the printed version of this last evidence of his sound judgment, progressive outlook, and keen enthusiasm in the cause of organic chemistry. The production of the book was supervised by his colleague, Dr. Neil Campbell, from Dr. Rule's complete revised manuscript; another colleague, Dr. E. G. V. Percival, revised the section dealing with carbohydrates.

The general character of the book remains unaltered. It is planned methodically upon a structural basis, leading to a systematic survey of the manifold organic types. There is an adequate, but not obtrusive, treatment of the physical background, and the stereochemical and biochemical aspects of the subject are well developed. Among themes of current interest which come under discussion in the new edition we may mention resonance, the electronic theory of benzene substitution, deuterium compounds, chromatography, synthetic plastics, chemotherapy, vitamins, hormones, and steroids.

The book is well printed, well documented, and well indexed. It is one of the most useful text-books of advanced organic chemistry available at the present time. This opportune edition will come as a boon to hard-worked honours students as a standard and up-to-date treatment of a vast and rapidly expanding branch of science; others will welcome it as a valuable book of reference. JOHN READ.

Frequency Modulation

By K. R. Sturley. Pp. 58. (London : The Hulton Press, Ltd., 1942.) 2*s*. 6*d*. net.

THE communication of intelligence by means of radio frequency electric waves is effected either by interrupting the waves into groups of long and short duration, or by varying the amplitude, frequency or phase of the waves in some controllable manner. Radio telephony as used for broadcasting and other purposes all over the world has hitherto been based very largely upon the varying amplitude type of modulation. The principles of frequency modulation, in which the frequency of the carrier waves is varied about its mean value at a rate depending upon the modulation requirements, have been known for many years and have been applied to such purposes as the determination of the height of the ionosphere or the altitude of aircraft. During the past decade, however, work conducted notably n the United States has demonstrated the merits of frequency modulation for broadcasting, particularly n the improvement of the signal-to-noise ratio obtained at the receiver. A number of broadcasting stations using frequency modulation on the ultra-short wave-length band below 10 metres have been in operation for some years.

With this growth of radio technique, it is natural hat there should be a demand for literature in various forms. It is therefore of interest to direct attention to a very useful monograph recently pubished by Dr. K. R. Sturley. This booklet, of a very handy size, is based upon a series of articles published in *Electronic Engineering*, and completely evised for publication in its present form. It deals in the first place with the general principles and the advantages and disadvantages of frequency- and phase-modulated transmissions, and with methods of producing the required modulation. The remainder of the monograph then discusses the frequency modulation receiver, including a full analysis of the circuit requirements, and typical calculations which should prove of great value to the designer of such a receiver. While no frequency-modulated broadcast transmissions have yet been authorized in Great Britain, many students and workers in the subject will be indebted to the author of this booklet for having collected together and summarized in such a clear manner the state of our present knowledge.

The editor of *Electronic Engineering* states that his is intended to be the first of a series of technical monographs on specially interesting radio and electronic subjects, to be issued in a uniform style. Additions to the series will be awaited with interest.

The Journal of the Institute of Metals

Vol. 68, 1942. Edited by N. B. Vaughan. Pp. xxxii+430+37 plates. (London : Institute of Metals, 1942.)

IT is, of course, impossible to give an adequate account of the papers comprising this volume without occupying considerable space. The practical importance of the information given, however, may be indicated by brief references to some of the conclusions reached, and invidious distinction may be avoided.

In a series of papers on bearing metals, a laboratory test is described for measuring the adhesion of bearing metal to backing material on laboratory specimens, and another for examining the strength of the bond at different locations in manufactured bearings. The first is used to examine the effects of time and temperature of pre-tinning and composition and thickness of coating on the bond obtained with different bearing metals. One investigator shows how poor adhesion of tin-base bearing metals may frequently be caused by the presence of shrinkage cavities at the inter-face between white metal and shell, resulting from unsatisfactory casting conditions. Railway practice in the use of white metal bearing materials is described with admirable frankness, and details are given of two methods now in production for the separation of white metal and bronze bearings.

Investigations on the factors influencing the cold pressing properties of duralumin sheet have led to improvements, resulting from a modified rolling technique, to the development of a more favourable microstructure, in which the inter-metallic compounds are distributed with greater uniformity. The mechanical properties of metal foils have also received detailed attention, as a result of which tests have been devised, throwing light on the fundamentals involved and enabling a quantitative determination to be made of the factors governing service behaviour in such applications as bottle-caps.

Although our knowledge of the effects of impurities on the properties of copper is already very extensive, it has not been necessary until recently to pay much attention to selenium and tellurium, which have now become important, being present in certain coppers from Empire sources. Two papers in the present volume go a long way towards supplying the remaining information needed before best use can be made of these important raw materials.

Among other interesting and valuable contributions, there must be mentioned the fascinating story of a thirty-year investigation into the factors which affect the grain size of rolled aluminium. H. W. G. H.

Radio Goes to War

By Charles J. Rolo. Pp. 245. (London : Faber and Faber, Ltd., 1943.) 8*s*. 6*d*. net.

IT is proper that inventors be informed of the uses and abuses of their inventions. The last ten years has seen a change in the function of the verbal material of broadcasting. While this aspect in many countries remained somewhat pedestrian, the new Continental ideologies found in it a weapon of propaganda and confusion, sufficiently novel and devastating to sabotage whole nations. All present belligerents now use this bloodless weapon on a scale and with policies comparable in magnitude to those controlling the active forces on land and sea and in the air. Monitoring posts eagerly analyse up to a million words a day emanating from the enemy, inserting replies in a hundred daily news bulletins in perhaps forty different languages, all subtly urging some section of a community to do something of which it can have no independent judgment.

The author has great experience in this field and shows how the technique has developed during the present hostilities, where it wins and where it fails. He gives detailed factual histories of "Lords Haw-Haw" and "Hee-Haw", the V-campaign, the rallying of the Free French, the subversive secret stations, the hit and parry between Berlin and the Kremlin; and the feeble imitations by the Japanese, all conducted through the submissive ether. The only sign of civilization is the mutual reluctance to jam. Few can appreciate the intensity of this radio war. For the future, everyone should know that the radio is a trigger to be pulled at any moment to stir up the latent forces on the Continent of Europe on behalf of those oppressed. L. E. C. HUGHES.

FLUORESCENCE OF ORGANIC MOLECULES*

By DR. JOSEPH WEISS
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FLUORESCENCE is the emission of light of a colour generally different from that of the incident radiation. The question arises: which organic substances might be expected to exhibit fluorescence, or perhaps, under what conditions do certain organic substances show fluorescence.

Although this problem has not yet been solved, our increasing knowledge of the mechanism of light absorption in molecular systems makes it possible to outline a few general ideas regarding the fluorescent properties of organic molecules.

Theoretically, fluorescence represents a simple quantum process where an absorbed light quantum is again emitted as light, generally of a somewhat different frequency. In fact, however, this represents the exception rather than the rule, as a large number of organic molecules which absorb in the visible region of the spectrum or in the near ultra-violet do not show fluorescence. In these cases one may say that the fluorescence is 'quenched' and the absorbed light energy appears in other forms of energy, usually as heat.

There are obviously two ways in which the optical (electronic) excitation energy can be converted into heat:

(*a*) Internal quenching, within the molecule itself.

(*b*) External quenching, which occurs in those cases where the molecule shows fluorescence under certain conditions but this fluorescence disappears in the presence of other (interacting) substances.

In the latter case one is in a position to study the conditions under which quenching occurs, and the study of external quenching has proved very useful in the elucidation of these problems, particularly in solutions. A good example of this is provided in the quenching of fluorescence of various dyes, methylene blue, thionine, etc., by simple ions such as I^-, Fe^{2+}.

A closer study of these reactions has shown[1] that the mechanism of light absorption and quenching can be represented by the following simple elementary processes (where D represents dye molecule):

(1) light absorption : $D + h\nu \rightarrow D^*$ (excited dye) ;
(2) fluorescence emission : $D^* \rightarrow D + h\nu_1$;
(3) quenching : $D^* + Fe^{2+} \rightarrow D^- + Fe^{3+}$.

This is followed by the formation of the colourless leucobase of the dye:

$$D^- + H^+ \rightleftarrows DH\,; \quad 2DH \rightarrow D + DH_2 \text{ (leucobase).}$$

The nature of the quenching process (3) was first revealed by the use of a very strong light source which showed a (reversible) bleaching of the solution, whereas in the following dark period the leucobase is re-oxidized to the dye by the Fe^{3+} formed, thus completely restoring the initial state.

Another important type of quenching occurs, for example, in the case of the polycyclic carcinogenic hydrocarbons or chlorophyll, which are of some biological interest. The fluorescence of these substances is quenched by molecular oxygen[2,3], and as we have found recently also by nitric oxide, whereas carbon monoxide and nitrous oxide are without effect[3].

The elementary process of quenching can be represented by the following sequence of reactions (HC stands for the organic molecule) :

(4) light absorption $(HC) + h\nu \rightarrow (HC)^*$;
(5) fluorescence $(HC)^* \rightarrow (HC) + h\nu_1$;
(6) quenching
  (*a*) by oxygen $(HC)^* + O_2 \rightarrow (HC)^+ + O_2^-$;
  (*b*) by nitric oxide $(HC)^* + NO \rightarrow (HC)^+ + O_2^-$.

In general, reactions (6*a*) and (6*b*) are completely reversible in the dark, that is, if oxygen or nitric oxide is replaced by an atmosphere of nitrogen, or is pumped off, the original fluorescence is completely and instantaneously restored. Under certain conditions (with prolonged irradiation) the primarily formed peroxides or nitroxides can be stabilized to some extent and have in some cases been isolated in pure form, thus also supporting the quenching processes proposed above.

Many substances which fluoresce in solution lose this power to some extent with increase in concentration. This phenomenon of 'self-quenching' has been known for some time, but was not well understood Pringsheim[4] has pointed out recently that it cannot be due to the simple formation of associated molecules as there is a shortening of the actual life-time of the excited state which runs parallel to the quenching He suggested that 'self-quenching' in the case o anthracene in solution is connected with the photochemical formation of dianthracene.

A detailed study of the self-quenching of a number of carcinogenic hydrocarbons and of chlorophyll in solution has led us to the conclusion that this apparently represents quite a general phenomenon The elementary process of 'self-quenching' is represented by:

$$\text{(7) self-quenching: } (HC)^* + (HC) \rightarrow (HC)^+(HC)^- \qquad (HC)_2 \rightarrow 2(HC),$$

resulting in the primary formation of a photo dimer In general, this reaction is reversible in the dark although in certain cases (for example, anthracene) a partial stabilization of the dimer may occur.

The 'self-quenching' process often depends on the medium (solvent). Stabilization of all these photochemical association products also depends greatly on the partner in the three-body collision. Ou experiments indicate that there are only certain molecules (probably mainly another (HC) molecule which are appreciably efficient as third bodies.

Another consequence of 'self-quenching' is seen in the fact that some substances which do not show fluorescence in the solid state often exhibit fluorescence in mono-molecular (adsorbed) layers. Some dyes (for example, crystal violet) which do not fluoresce in solution often show fluorescence when embedded in a solid substance (for example, boric acid, sugar, gelatine). It can be shown that when there is no free diffusion, as in these solid phosphors the relationship between fluorescence yield (γ) in the stationary state and the concentration of the dye (c is given by

$$\gamma = \frac{k_1}{1 + k_2 c\,(1 - e^{-\omega c N})}, \qquad (8)$$

where N is Loschmidt's number. This differs by th term within the bracket from the ordinary (hyperbolic) quenching equation. This term takes into account the fact that self-quenching in the rigid medium occurs only when there is at least one dy molecule within the sphere of action (ω) of the fluorescent molecule. For small concentrations of the dye, the fluorescent yield is therefore increased as compared with liquid solutions.

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* Substance of a lecture delivered to the Chemical Society of the University of Manchester, on February 17

The foregoing discussion leads to the conclusion that absorption of light results either in (*a*) fluorescence, or (*b*) photochemical interaction. This fact has often not been recognized in the past mainly for the following reasons: (i) Sometimes (usually) the intensity of the light source is too weak, so that permanent changes do not manifest themselves. (ii) The photochemical primary processes are often completely and rapidly reversible in the following dark periods.

There is one characteristic feature common to all organic molecules which show appreciable fluorescence in the visible or near ultra-violet, namely, all these molecules (dyes, aromatic hydrocarbons, etc.), without exception, are composed of systems of conjugated double bonds.

It is well known that the non-localized π-electrons present in these systems behave in many respects like electrons in a metal. The electron levels in these molecules correspond to the Brillouin zones in a metal[5], and the mechanism of fluorescence and quenching outlined above can also be interpreted from this point of view.

When a light quantum is absorbed in such a molecule, the electron will make a transition from a state in the filled band to a corresponding state in the unfilled upper band. If the electron recombines again with the hole left in the lower band, this will result in fluorescence emission (Fig. 1*a*).

On the other hand, quenching occurs if the excited molecule comes in contact with another molecule (or ion), which provides another localized electronic level (normally vacant) between the allowed bands into which the excited electron from the upper band can be trapped (Fig. 1*b*), corresponding to reactions of the type (6*a*), (6*b*); or there is the other possibility that an electron of the quenching substance (in collision with the excited dye) neutralizes the hole left in the lower band (Fig. 1*c*, corresponding to the reactions of type 3).

In both cases, either the excited electron or the hole created by the absorption of light is removed and fluorescence is prevented.

Similar considerations can be applied to the question of 'internal quenching' in molecules, and this leads directly to the problem of fluorescence and chemical structure (in the absence of external quenching).

As pointed out above, the presence of loosely bound electrons is apparently a necessary condition for fluorescence. If the electrons were actually 'free', then primarily absorbed light would *always* have to appear as 'fluorescence' because 'free electrons' cannot absorb radiation (on account of the conservation of energy and momentum). Light energy can only be absorbed by the electrons if there is some coupling between electronic motion and molecular vibrations.

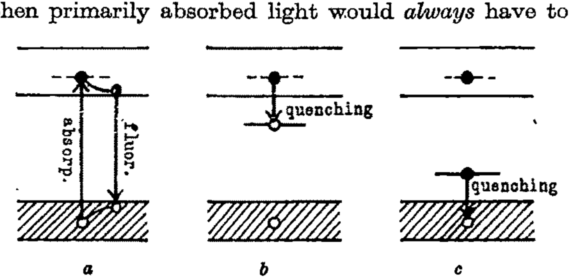

Fig. 1. SCHEMATIC REPRESENTATION OF THE ABSORPTION OF LIGHT, EMISSION OF FLUORESCENCE AND QUENCHING IN MOLECULES WITH SYSTEMS OF CONJUGATED DOUBLE BONDS.

(*a*) emission of fluorescence (in the absence of quenching); (*b*) quenching by a substance with an empty electronic level into which the electron can fall; (*c*) quenching by a substance which has a level with loosely bound electron.

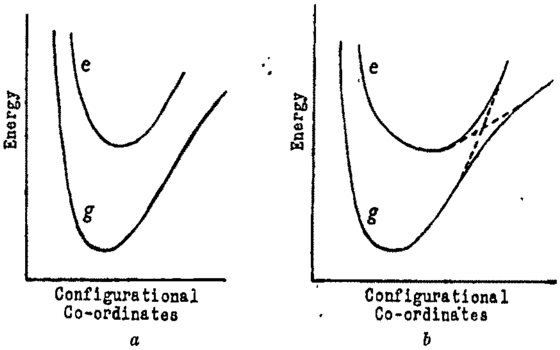

Fig. 2. SCHEMATIC REPRESENTATION OF THE POTENTIAL CURVES OF THE GROUND STATE (*g*) AND THE EXCITED STATE (*e*): (*a*) for small interaction; (*b*) for strong interaction (crossing).

So long as there is complete resonance within the molecule, there is no appreciable coupling with the molecular vibrations, and the optical excitation of a loosely bound electron will not result in any appreciable change of the nuclear configuration. Consequently, the potential curve of the excited state will not differ appreciably in shape from that of the ground-state (Fig. 2*a*).

The situation is different when one introduces an atom or group into the molecule (for example, a halogen, nitro group, etc.) which has a certain 'electron affinity' or which in some other way exerts strong forces towards the excited electron, thereby providing localized levels where the electron can be 'trapped' (similar to the case of Fig. 1*b*). In this case these strong forces will tend towards a distortion of the nuclear configuration, and this will in general result in a 'crossing' (near approach) of the two potential curves which will now be very different in shape (Fig. 2*b*). This 'crossing' of potential curves is an essential condition for the (non-adiabatic) transformation of electronic excitation energy into vibrational energy or chemical energy, which then appears as heat[6]. This is shown, for example, in the case of fluoresceine sodium, which has a high fluorescence yield in solution, whereas this yield is strongly decreased in its halogen derivatives (eosin, erythrosin). It is clear also that self-quenching effects are enhanced in molecules with 'trapping centres'.

There is also an important difference in the behaviour of the π-electrons in cyclic structures as compared with conjugated chains. In cyclic structures the electrons are circulating uniformly around the rings, as is also shown by the large diamagnetic anisotropy of these molecules[7]. This is different in the chains because there the phase of the electron waves at the ends of the chain, and the electron density, are determined by the boundary conditions, that is, the electrons are only 'free' towards the centre of the chain, but more or less localized at the ends. For localized electrons the probability of a radiationless transfer is considerably greater and this is presumably the reason why fluorescence is more often found in cyclic structures than in chains (for example, polycyclic aromatic hydrocarbons compared with polyenes, fluorescein compared with phenolphthalein).

Molecules which are capable of fluorescence can often act as photosensitizers in photosensitized oxidations or in photographic emulsions, and they are sometimes also of some biological interest (for example, chlorophyll, carcinogenic hydrocarbons). As illustrated above, the striking feature of all these fluorescent molecules is that they are capable of reversible oxidation-reduction processes involving only simple electron transfer reactions.

It has been shown that these reactions are also responsible for their photosensitizing action[1], and their biological significance is presumably also a result of this 'electronic reactivity'.

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[3] Weil-Malherbe, H., and Weiss, J., NATURE, **149**, 471 (1942); **151**, 449 (1943).

[4] Pringsheim, P., *Trans. Faraday Soc.*, **35**, 48 (1939).

[5] London, F., *Compt. rend.*, **208**, 2059 (1939).

[6] Mott, N. F., and Gurney, R. W., "Electronic Processes in Ionic Crystals" (Oxford University Press, 1940).

THOMAS JEFFERSON AS NATURAL PHILOSOPHER

By Dr. HARLOW SHAPLEY

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PREVIOUS speakers [in the symposium arranged by the American Philosophical Society during April 22–24 to commemorate the two hundredth anniversary of the birth on April 13, 1743 of Thomas Jefferson] have easily encroached upon my subject, doubtless finding it difficult to consider the versatile Jefferson as a lawyer, a farmer, a diplomat, a traveller, without discussing also his thoughts and acts in the broad field of natural philosophy. Thus the famous contribution on the mould-board of the plough has been discussed, as well as the observations and speculations on climate, ethnology, and palæontology. My remarks can therefore be in the nature of miscellaneous supplementary notes.

Jefferson had a telescope. He was keenly and practically interested in surveying and navigating, and in the astronomical measurements required by such work, but he was in no sense an astronomer. His curiosity about the non-terrestrial was, however, healthy; and his admiration for the famous self-taught David Rittenhouse of Philadelphia brought him into frequent contact with practical and speculative astronomical questions. He used his telescope during the annular eclipse of the sun of September 17, 1811, and reported his observations both carefully and modestly. Towards the end of his life he used the telescope to watch, from his mountain home, the workmen building the University of Virginia.

Like all daring thinkers and workers in the pioneer days of so many of the sciences, Jefferson sometimes went to extremes. These misadventures were so few, compared with his successes, that one should not mention them at all except to prevent the impression that he was actually omniscient and infallible. Naturally he became cautious. When, for example, spectacular reports were made about shooting stars, he was sceptical. According to the Honourable S. A. Mitchill's account, Jefferson declined to accept the story of the meteoric fall in Connecticut in December, 1807. He did not like this Connecticut story; and he did not like the way the Connecticut Yankees pronounced their Latin, either. There was, indeed, no love lost, for it is notorious how vigorously much of Connecticut disliked this Virginia advocate of religious tolerance. They reported showers of stones from the Connecticut clouds—he discounted the claims at once and said, according to Mitchill, that five words would be sufficient for a response. They were short words—"It is all a lie!"

But later, when the evidence concerning the meteoric fall became clearer, Jefferson reconsidered the matter and recommended that competent authorities of the American Philosophical Society might look into it. He first pointed out, however, that the sending of the Connecticut stones to Congressmen was not necessarily the most profitable procedure, in view of the limitations of those particular gentlemen. The letter on the meteoric stones to Mr. Daniel Salmon is dated February 15, 1808, and is worth quoting as an illustration of Jefferson's scientific attitude.

"Sir, I have duly received your letter of the 8th instant, on the subject of the stone in your possession, supposed meteoric. Its descent from the atmosphere presents so much difficulty as to require careful examination. But I do not know that the most effectual examination could be made by the members of the National Legislature, to whom you have thought of exhibiting it. Some fragments of these stones have been already handed about among them. But those most highly qualified for acting in their stations are not necessarily supposed most familiar with subjects of natural history; and such of them as have that familiarity, are not in situations here to make the investigation. I should think that an inquiry by some one of our scientific societies, as the Philosophical Society of Philadelphia for example, would be most likely to be directed with such caution and knowledge of the subject, as would inspire a general confidence. We certainly are not to deny whatever we cannot account for. A thousand phenomena present themselves daily which we cannot explain, but where facts are suggested, bearing no analogy with the laws of nature as yet known to us, their verity needs proofs proportioned to their difficulty. A cautious mind will weigh well the opposition of the phenomenon to everything hitherto observed, the strength of the testimony by which it is supported, and the errors and misconceptions to which even our senses are liable. It may be very difficult to explain how the stone you possess came into the position in which it was found. But is it easier to explain how it got into the clouds from whence it is supposed to have fallen? The actual fact however is the thing to be established, and this I hope will be done by those whose situations and qualifications enable them to do it."

Much earlier than the epoch of the meteor shower and the annular eclipse, Jefferson had developed a considerable interest in certain problems of cosmogony. During his long stay in France he had become acquainted with many of the leading men of science. Among them was the famous Buffon, the great naturalist and the encyclopædic writer on scientific subjects. Buffon got some of his biological specimens from Jefferson, and was generous enough to write, "I should have counseled you, sir, before publishing my Natural History, and then I should have been sure of the facts." It was a fine compliment, in the Parisian style. It is scarcely imaginable now that a man of science would seek the advice of a leading national politician in order to get his facts straight.

The "Epoques de la Nature", written by Buffon about 1780, received excited attention throughout Europe. It was but one part of the "Histoire Naturel" with which he was long associated and which appeared during forty years in almost numberless volumes. One particular theory in "Epoques de la Nature" disturbed Jefferson. He wrote about it, in 1784, to the Rev. James Madison:

"It has occurred to me to reflect a little more on Buffon's central heat than I did at the moment of our conversation and to form an opinion different from what I then expressed. The term 'central heat' does not of itself give us a false idea of Buffon's hypothesis. If it means a heat lodged in the center of the Earth and diffusing its warmth from thence to the extremeties, then certainly it would be less in proportion to the distance to that center, and so forth. Of course less under the equator than the Poles, on high mountains than in deep valleys. But Buffon's theory is that this Earth was once in a state of hot fusion, and that it has been, and still continues to be cooling. What is the course of this process? A heated body being surrounded by a colder one, whether solid or fluid, the heat, which is itself a fluid, flows from the colder body equally from every point of the hotter. . . ."

Jefferson, of course, subscribed to the current fluid theory of heat, universal at that time; but it is noteworthy that he also states one of the basic laws of thermodynamics. He goes on in the letter to Madison to reason that on the Buffon hypothesis the earth should be hotter at the poles than at the equator, contrary to observation, and contrary to the conclusion derived by Buffon, who says that the earth, being thinnest at the poles, will cool sooner there than under the equator where it is thicker. Jefferson concludes, "If my idea of the process of cooling be right, his is wrong and his whole theory in the Epochs of Nature is overset."

In general, the natural philosophy of Jefferson was of the practical sort. Apparently he was somewhat soured by the speculators on the origin and age of the earth. But he rather skilfully avoided the controversy of his time as to the origin of fossil shells on the mountain tops. He would not commit himself that they were remnants of the sea-line of the time of Noah's Flood; or evidence of the rising ocean waters having covered the peaks; or one of those strange manifestations of the All-wise which permits shell-like formations to grow through the ages in the same way that queer rock formations and crystals are formed without associated organisms.

His interest in geology was chiefly confined to a practical interest in mining and in the related field of palæontology. His enthusiasm for fossil bones led him to the inquiries and writings and collecting that have given him right to the title of founder of American palæontology. As has been told fully elsewhere, and many times, he brought along to the scientific men and museums of Philadelphia a collection of remarkable bones when he journeyed to that city to become the Vice-President of the United States. Those fossils, one hundred and fifty years later, are on proud display. Later he built up at Monticello a much greater palæontological collection. It dominated the famous residence.

The steam engine was one of the practical scientific developments of his time that had a peculiar appeal to Jefferson. It inspired him to seek the possibility not so much of transportation nor of man's manufacturing, but rather the emancipation of the individual citizen from the drudgery of chores. He viewed the advances of science in terms of the practical problems of his plantation. If the tea kettle could only be developed into a practical steam boiler, the water could be pumped to the tops of the houses; the household machinery could be operated by water power, and hands released for the fields. Jefferson went from France to England especially to see Watt and his famous engine; but the canny inventor, or his advisers, saw to it that this shrewd and inventive Virginian did not get a close look at the details.

Thomas Jefferson was interested in the precious metals from two points of view—the coinage of the United States, and the mining industry. While Vice-President of the United States he was attracted by the problems of the copper mines at Newark, New Jersey. Miss Adams has just recently published from the Boston Public Library a letter, heretofore unpublished, touching on this subject. Jefferson wrote to Elisha Boudinot in Newark concerning the resources of the Schuyler copper mines, which operated some three miles north of the town from 1719 until 1775, and later. There is one sentence in that newly published letter which indicates an early contact of the Roosevelt family with the White House. Was it prophetic? The sentence is, "As soon as you receive Mr. Roosevelt's answer I shall be further thankful for the communication of it." A matter of incorporation was involved, and one may assume that the awaited answer came in good time from Nicholas Roosevelt, who was the great-great-grand-uncle of some later tenants of the White House.

In 1790, when George Washington was President of the United States and Thomas Jefferson the Secretary of State, the latter was asked to make a report on weights and measures suitable for the new federation of States. The subject naturally interested one with such wide scientific and social interests as Jefferson, and one who had had close contacts with the reforms and innovations in France. He made recommendations that in a way resulted in the founding of the Bureau of Standards. More than twenty years later, Jefferson was writing to Dr. Robert Patterson concerning the project that the American Philosophical Society should look into the subject of fixing standards of measures, weights, and coins. He was a member of a committee charged with examining the problem. With a fine sense of the disadvantage of working with a committee from a distance, Jefferson modestly remarked, in the introduction to a long letter on the subject: "Isolated as is my position, I am sure I can offer nothing but what occurred to the committee engaged on it, with the advantage on their part of correction by an interchange of sentiments and observations among themselves. I will, however, hazard some general ideas, because you desire it, and if a single one be useful, the labor will not be lost."

It is of interest that a major part of this letter is devoted to the question of the appropriate diplomatic techniques necessary to get co-operation in Europe with an American innovation. All must be handled delicately, with full consideration of the prides and prejudices and sensitive vanities of the Governments of the foreign nations. He writes:

"With England, our explanations will be much more delicate;"—he is writing about the possibility of international agreement on a decimal system for weights and measures—"they are the older country, the mother country, more advanced in the arts and sciences, possessing more wealth and leisure for their improvement, and animated by a pride more than laudable . . . The subject should therefore be opened to them with infinite tenderness and respect, and in some way which might give them due place . . . ." His approach reminds one of the techniques and tendernesses necessary at the present time in advocating international fellowship.

Jefferson makes an interesting commentary ("Writings", **13**, 105) on the English gentleman as an amateur man of science. "We (in Virginia) are all occupied in industrious pursuits. They abound with persons living on the industry of their fathers, on the earnings of their fellow-citizens, given away by their rulers as pensions. Some of these, desirous of laudable distinction, devote their time and means to the pursuits of science, and become profitable members of society by industry of a higher order."

Returning to his consideration of units of weights and measures, Jefferson proposed, in one crystal clear sentence, unmatched in my experience for simplicity and completeness, the following:

"That our unit of measure then be a pendulum of such length as in the latitude of 45°, in the level of the ocean, and in a given temperature, shall perform its vibrations, in small and equal arcs, in one second of time."

His uncommon gift for clear writing could not be better illustrated. But his proposal was not accepted. His arguments against the unit of the one ten-millionth part of the distance from the pole to the equator were to the point. But it takes more than clarity and logic to simplify the deeply rooted system of weights and measures.

Jefferson's "Notes on Virginia" were among his most noteworthy writings. To me they demonstrate more clearly than anything else that if he had been free from his national political life he could have readily developed into one of the leading men of science of his time and country. His "Notes" touched all phases of the natural history of the region, and dealt with its people and its government. There were many editions, many translations. But he viewed his accomplishments with modesty. On September 25, 1785, he wrote to Francis Hopkinson: "I have sometimes thought of sending a copy of my Notes to the Philosophical Society as a tribute to them, but this would seem as if I considered them as worth something, which I'm conscious they are not. I will not ask you for your advice on this occasion, because it is one of those on which no man is authorized to ask a sincere opinion. I shall therefore refer it to further thought."

How many an editor has wished that his scientific contributors would refer their compositions to further thought!

The "Notes" were written in the war years, 1781 and 1782, and therefore we should make some allowance for Jefferson's rather stinging comparison of *little* America with Great Britain and great France, so far as the production of genius is concerned. His war-time comments on Britain: "The present war so long having cut off communication with Great Britain, we are not able to make a fair estimate of the state of science in that country. The spirit with which she wages war, is the only sample before our eyes, and that does not seem the legitimate offspring either of science or of civilization. The sun of her glory is fast descending to the horizon. Her philosophy has crossed the Channel, her freedom the Atlantic, and herself seems passing to that awful dissolution whose issue is not given human foresight to scan." For four hundred years worried men have predicted the impending dissolution of Britain. She has always been in a state of rapid decline!

One could continue at length with quotations that show the sensitiveness, the vast learning, the curiosity, and the originality of this astonishing Virginia farmer. He had, as they say, pretty nearly everything. In the field of natural philosophy he had caution and daringness, inquisitiveness and a willingness to change his mind in the light of new facts or as a result of further thought. What we would now call proper scientific methods and attitudes appeared to be instinctive with him.

His scientific creed is illustrated in his response to the Abbé Raynal's taunt, that America had produced no poet, no mathematician, or man of genius in any art or any science. In his "Notes on Virginia", Jefferson asked for time with regard to the poet; but pointed to Washington and Franklin (as well he might) as leaders in the soldier's craft, and the craft of physics; and concerning the Philadelphia astronomer he wrote, "We had supposed Mr. Rittenhouse second to no astronomer living; but in genius he must be the first, because he is self-taught. As an artist he has exhibited as great a proof of mechanical genius as the world has ever produced. [A famous orrery is referred to.] He has not indeed made a world; but he has by imitation approached nearer its Maker than any man who has lived from the Creation to this day." In a footnote he points out that the European nations traverse the globe with the aid of Hadley's quadrant, which was actually invented by the American Godfrey.

But to return to the scientific creed. The Abbé Raynal later withdrew his taunt with regard to the North Americans; but still disparaged the South Americans. In a footnote Jefferson questions the sufficiency of the Frenchman's knowledge, and the depth of his research on the subject concerning which he was writing. He indicated how the nationality and conditions of the interpreter might well affect the interpretation, and concluded with the unforgettable statement:

"A patient pursuit of facts, and a cautious combination and comparison of them, is a drudgery to which man is subjected by his Maker if he wishes to obtain sure knowledge."

THE WAY AND SPIRIT OF SCIENCE*

By Generalissimo CHIANG KAI-SHEK

Chairman of the Military Affairs Commission of the Republic of China and Supreme Commander of the Chinese Armies

The Scientific Approach

PROCEED from the immediate to the distant, from the low to the high; attain the great through the small, the difficult through the simple. To accomplish great and important things, it is necessary to start from the nearest, simplest, and most minute matters, enlarging and expanding gradually in systematic order.

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* Abridgment of an address by Generalissimo Chiang Kai-shek, given in 1942; translated by Huang Hsing-Tsung and Dr. Joseph Needham, F.R.S. Note that the word "Way" has a special significance in Chinese philosophy. The address is posted in all Chinese Government laboratories and workshops.

Competence in small things precedes competence for big affairs; first know how to do commonplace things well; afterwards talk of doing work of special importance. Know how to solve small and easy problems; afterwards you may be successful in rare accomplishments. Never run after speculations and far-reaching conclusions, missing out immediate stages and hoping for lucky shots. Your work will only be superficial; short cuts will not lead to the desired aim, and nothing solid will be accomplished.

The Scientific Spirit

In order to investigate thoroughly all the phenomena of man and Nature, our attitude towards anything should be, not only to attempt understanding of what is not understood, and to make experiments where the previous experiments have not been satisfactory; but also to understand further what is commonly supposed to be already understood, and to improve further those experiments which have already been commonly considered satisfactory. The more knowledge grows, the more the lack of it is felt. The greater one's accomplishment, the more intensely the smallness of one's ability is realized. But it is through this very feeling of inadequacy and insignificance that knowledge and achievements can continually progress.

Never be satisfied with obtaining one result or even a small success. Whatever be the department of knowledge one is investigating or whatever kind of work one is to do, it is necessary before starting to consider properly the facts of the case, avoid all vagueness in defining the aim and be sure about the method to be employed. Once started, be determined to carry the project through, working unceasingly and meeting every obstacle with undaunted resource.

Many young men of to-day have no understanding of this principle. They will start to study a subject or work on a project, but when they meet the slightest obstacle or disappointment, instead of holding on doggedly and industriously, they will merely skip the difficulty and turn over to some other easier problem. This mental unsteadiness, chopping and changing time after time, will never bring any result.

There are also many who have as their main object in life the attainment of wealth or high official position, and if they find themselves engaged in work where these aims seem to have little or no hope of realization, they will discard it without any consideration, however important it may be, and creep into some new path. Such opportunists, consulting only their own selfish interests, have no responsibility to the country and the people.

The Scientific System

Limitations. In doing anything we must first know the limitations of the question; in other words, one must be quite clear about one's object and aim. This is of prime necessity, for one can then concentrate time and energy upon possibilities within the frame of reference. Thus one can avoid all distractions from other sources; and one will not try to do several things at once. If we think of attacking one problem to-day, another to-morrow, and still another the day after to-morrow, finally nothing will be accomplished. In investigations and affairs it is essential to define the central idea. Only if this is done can we distinguish between the roots and branches of things, avoiding confusion between the first and the last. A clear idea of the order of things, which stands the test of practice, is required for the success of any research.

Management. All reasonable scientific organization must satisfy the following requirements: (*a*) a vertical definite dendritic order; (*b*) a horizontal intimate co-ordination. The vertical order embodies the relation between the upper and the lower, the deriving to the derived, levels of organization. Such relation must be well understood before the organization can be effectively controlled and steered with ease. The horizontal co-ordination embodies the relation between each small part of the organization to every other part, so as to give harmony in operation. Such relations must be intimate before the different portions can achieve complete co-ordination, and the organization run with maximum efficiency.

Recording and Preparation. Before beginning work on any subject, collect every type of material available, examine it carefully, and presuppose all possible situations which may be encountered at different later stages, using all possible intelligence and resourcefulness. Consider the preparation of different types of formulæ to meet different situations so that at any stage of the work the most satisfactory formula can be produced. Only those who are thoroughly industrious and persevering in thought, only those who have different solutions and formulæ prepared beforehand, can meet every situation with calmness and ease. However difficult the matter in hand may be, in the end they find the solution which carries them through.

Division of Labour and Co-operation. The advance of human civilization has been entirely due to division of labour and co-operation. Whether it be knowledge or practical affairs, division of labour is necessary for specialization, and co-operation is necessary for success. For the intelligence and ability of one single man are limited; hence each man has to select a particular branch of knowledge for investigation or a special type of practical work to do; only then is the highest efficiency attained. Then the results of different investigations have to be unified and co-ordinated, and the entire whole of knowledge and achievements makes real progress. We Chinese suffer from a great lack of co-operation in knowledge and affairs. In our scholarly researches there is not enough discussion and mutual understanding; and in our affairs there is little sympathetic and helpful co-ordination; thus the research spirit is low and few things are done well and effectively.

Research. The progress of science and the improvement of the lot of man have been due to the efforts of research. These were not accomplished by people who are content to work to strict office hours. In the West, work is carried on not only in the normal working hours, but even free time is not wasted. For example, Sundays have been found just the right time for intellectual investigations. If we are to save our country, we must break through the present lethargic and pessimistic psychology, and cultivate an industrious and persevering spirit, dedicating oneself to research with all one's heart and mind.

Experimentation. Many of the results of investigation and observation are only theories which have to stand the test of experiment before it can be shown whether they are correct and suitable for practical purposes. If experimentation shows flaws in the theory, then it is necessary (according to the facts of the case) to study more carefully, trying various improvements until as satisfactory a hypothesis is obtained as possible. If one still fails, the reasons for failure must be further inquired into, and corrections made accordingly. The ideal type of research worker is one who stands firmly by the scientific attitude (the objective outlook), observes facts and circumstances objectively and with humility, and draws his conclusions therefrom. Then only will there be any hope of knowing the truth.

Analysis and Statistics. When any plan or project of work shows development at the experimental stage, whether good or bad, one must collect and analyse the mass of material on hand, find out where the defects or good points are, decide whether the plan is workable and how far progress has been made, and in which direction and along what lines future developments are to take place. This statistical and analytical ability and the power for precise decision are fundamental in the success or failure of our research or practical work. Without the analytical and decisive mind it will not be possible to see clearly and objectively the relevant facts, and one falls into a mental state of chaos and disorder, failing to discover any likely approach to a successful conclusion.

Improvements and Inventions. To be conscious of mistakes is the most important factor in making progress. So in all our analytical examinations it is imperative to find the causes of these mistakes; only in this way shall we be able to find the required improvements. We must also persevere to discover those new principles, new methods, and new factors which are essential for general progress.

Conclusions. We live in an era of difficulty, suffering and danger. To be able to shoulder the heavy responsibility of reviving our nation and completing our revolution, we must have at all costs a clear idea of the content and meaning of science; we must propagate the spirit of science; and we must utilize the methods of science; so that one man will be as efficient as ten, and in one day ten days work will be done. While we are fighting intensely at the front for the mode of life we want, we cannot remain stationary at home; if we do not progress we shall degenerate; if we cannot achieve success we shall be ruined; if we do not prosper we shall be crushed; if we still refuse to gather our full strength our very existence will become impossible. From this day onwards, whatever it is we have to do, and whoever is doing it, there should be no more inefficient half-heartedness and no more spirit of fatalistic resignation.

OBITUARIES

Prof. David Hilbert, For.Mem.R.S.

News has reached Great Britain that Prof. David Hilbert, of Göttingen, died recently. He was born on January 23, 1862, and was a mathematician of tremendous power who ranged over a wide field and had an unusual influence on present-day mathematics. An indication of the breadth of Hilbert's influence is the number of mathematical topics which are associated with his name. For example, we have Hilbert space, Hilbert inequality, Hilbert transform, Hilbert invariant integral, Hilbert irreducibility theorem, Hilbert base theorem, Hilbert axiom, Hilbert sub-groups, Hilbert class field. Again we recall his contributions to the "Yellow-Backs": "Methoden der Mathematischen Physik" (with Courant), "Grundlagen der Mathematik" (with Bernays), "Anschauliche Geometrie" (with Cohn-Vossen), "Theoretische Logik" (with Ackermann).

The fact that Hilbert was able to produce outstanding original results in a large number of different branches of mathematics and mathematical physics is most remarkable in our times. It was made possible by his ability to concentrate completely on one subject for a time; when he had finished, he rarely returned to it or even cared to hear about it, not even recognizing his own results. However, when Hilbert did become interested in a subject, he was able to indicate so many possible lines of development that mathematicians were kept busy for decades afterwards on new problems.

There can be few mathematicians nowadays whose work does not in some way derive from Hilbert. His personality and naïve enthusiasm attracted to Göttingen many pupils and followers who will always delight in recalling their experiences there and in passing on some of the Hilbert anecdotes. Hilbert's devotion to mathematics was complete: he allowed no prejudices, racial or otherwise, to interfere. For example, despite violent opposition from his colleagues, during the War of 1914–18 he insisted on delivering a eulogy on Darboux and on Emmy Noether receiving the *venia legendi* at Göttingen.

While it is not possible to give here an account of Hilbert's work, it is worth while recording some of the main topics on which he concentrated at various periods: invariant theory, algebraic number theory, diophantine equations, integral equations, foundations of geometry, mathematical physics, calculus of variations, foundations of mathematics. A detailed study of his papers reveals the continuous development of his thought from "theology" back to "theology". In honour of his seventieth birthday a three-volume edition of his papers was published. Reviews of the volumes by Prof. L. J. Mordell, to which those who wish for a more detailed account of his work should refer, appeared in the *Mathematical Gazette* in 1932, 1934 and 1936. I had the privilege of being closely associated with Hilbert in the preparation of this edition. In conversation, Hilbert often affirmed that, much as he admired every branch of mathematics, number theory was for him the most attractive. By number theory he meant algebraic number theory rather than the number theory typified by Waring's theorem, for which he nevertheless found the first proof and by which he is perhaps best known in Great Britain to-day. His work on Waring's problem was totally unconnected in content and time from his main work on number theory. It is interesting to recall that, in connexion with a lecture by Prof. R. Fueter at the 1932 Zurich Congress, Hilbert asserted that the theory of complex multiplication (of elliptic modular functions) which forms a powerful link between number theory and analysis, is not only the most beautiful part of mathematics but also of all science.

Among Hilbert's papers, I will mention only a lecture in Paris in 1900, in which he stated his famous series of twenty-three problems. These were the problems which he considered most significant in mathematics at that time; not isolated questions but problems of such a general character that their solution was bound to have an enormous influence on the shape of future mathematics. The present time seems an opportune one, since so many mathematicians have given up their usual sort of mathematics, for another Hilbert to state the present position of the original problems, and to present a new series and thereby to orient the activities of mathematicians of the future.

OLGA TAUSSKY.

Dr. T. T. Groom

THOMAS THEODORE GROOM was born at Wellington, Shropshire, on May 16, 1863, and died in Oxford on March 26, 1943. After studying at the University of Heidelberg and University College, London, he entered St. John's College, Cambridge, in 1885 with an exhibition, and was afterwards awarded a foundation scholarship. He obtained a first class in the Natural Sciences Tripos Part 1 in 1887 and in Part 2 (Geology) in 1889, and gained the Harkness scholarship for geology and palæontology. In the same year he took first-class honours in the examination for the London B.Sc.

Groom's first post was as demonstrator in zoology at Leeds under Prof. L. C. Miall. He next became professor of natural history at the Royal Agricultural College, Cirencester. In 1899 he left Cirencester for University College, Reading, where he was lecturer in geology and zoology. In 1906, at the invitation of Prof. Lapworth, he went to Birmingham as lecturer in geology, and remained there until Lapworth's retirement in 1914, when he moved to Oxford, where he spent the rest of his life.

At first Groom's interests seem to have been equally divided between geology and zoology, but eventually the attractions of geology prevailed. Although his qualifications in both geology and zoology seemed to fit him especially for research in palæontology, his principal work was in field geology.

While still an undergraduate, Groom wrote a paper on the corallian echinoid Pelanechinus, of which he discovered one of the only three specimens known. By a detailed study of its structure he brought forward new evidence to show that this genus belongs to the Echinothuridæ, of which it is the earliest representative, living forms being found in the deep sea. In Pelanechinus he proved, for the first time, the existence of pedicellariæ in fossil echinoids.

After taking his degree at Cambridge, Groom spent a year at the Naples Zoological Station and investigated the early stages in the development of Cirripeds. The results of this work, for which he was awarded the D.Sc. of London, were published in the *Philosophical Transactions of the Royal Society*, **185** (1895), and *Quarterly Journal of Microscopical Science*, **37** (1895). Of Groom's work in geology his unravelling of the complex tectonics and geological history of the Malvern and Abberley Hills is of outstanding merit. The results of this investigation were published in a series of papers during the years 1899 to 1902 (*Quart. J. Geol. Soc.*, **55**, **56**, **57**, **58**) and a general summary of the work, including the Ledbury district, was given in "Geology in the Field" (1910), p. 698. In collaboration with his friend, Philip Lake, Groom wrote on the geology of the Silurian districts of Corwen and Glyn Ceiriog in North Wales (*Quart. J. Geol. Soc.*, 49, 64).

Groom's interests were wide. In palæontology, in addition to the early paper on Pelanechinus, he described new Cambrian hyolithids, trilobites and ostracods (1902), while in petrology he wrote on the igneous rocks associated with the Cambrian of the Malvern Hills (1901) and on a tachylite from Carrock Fell (1889). In geomorphology he gave an account of the effects of faults on the character of the seashore (1895). From 1907 until 1917 Groom spent much time in investigating the beds forming the boundary of the Silurian and Old Red Sandstone in the Llandeilo and other districts of South Wales. It is greatly to be regretted that this work was left unfinished and no account of it published. After 1910 his only publication was a short paper, in conjunction with W. K. Spencer, on Ordovician starfishes which he had discovered in Shropshire (*Geol. Mag.*, 1934). Groom was a stamp collector and made some contributions to the literature of philately. His notebooks, zoological preparations and a few rock-slices were bequeathed to the Sedgwick Museum, Cambridge. The main part of his geological collection was left to the University Museum, Oxford. Owing to his long retirement from active work, Groom was personally but little known to the younger geologists of to-day. Those of his contemporaries who survive cherish the remembrance of a good friend and a genial companion.

H. WOODS.

Dr. E. C. V. Mattick

DR. ELFREIDA C. V. MATTICK (*née* Cornish) died in Reading on July 19, 1943. She was educated at Colston's School, Bristol, and took her qualifying degrees at the University of Bristol, working with Prof. J. W. McBain on a thesis dealing with the colloidal properties of soap solutions. She later took her doctorate at the same University. But she will best be remembered for her very long association with the National Institute for Research in Dairying at Shinfield, where she took up work on a Ministry of Agriculture Scholarship in 1913. For thirty years, but for a few months, she worked at Shinfield; in earlier years with Dr. Stenhouse Williams and Mr. J. Golding on the effects of heat treatment on the nutritive value of milk and later on the chemical changes taking place in the ripening of cheese, on the fat-splitting enzymes present in milk and milk products, on vegetable sources of rennet and on many other chemical and biochemical problems of practical importance in dairying.

Her first husband, Mr. Lionel Venn, was killed very shortly after her marriage during the War of 1914–18. Later, she married Dr. A. T. R. Mattick, now head of the Bacteriology Department at Shinfield.

During the last years of her life Dr. Mattick suffered from very bad health, but her enthusiasm for research and unfailing courage gave her the strength to continue her investigations in the laboratory until only a short time before her death. This triumph of a resolute mind over a failing physique was noted and admired by her colleagues, and her own slowly progressing illness never disturbed that kindliness and consideration for others for which she will long be remembered by all who knew her.

G. W. SCOTT BLAIR.

WE regret to announce the following deaths:

Sir Stopford Brunton, Bt., the well-known Canadian mining geologist, on July 25, aged fifty-eight.

Prof. J. Gibson, emeritus professor of logic and philosophy in the University College of North Wales, Bangor, on August 1, aged seventy-eight.

NEWS AND VIEWS

Substitute Materials

THE unfounded belief that a substitute is necessarily inferior to the material it displaces takes an unconscionable time to die. It is not long since a well-known member of Parliament objected to the incorporation of synthetic aneurin (vitamin B_1) into our bread, to replace that taken out with the germ, on the ground of adulteration. Replacement of a natural constituent by an identical artificial one cannot now reasonably be considered fraudulent; in fact, it is often economically advisable, and some of the substitutes that are in use as a consequence of war-time scarcity promise to outlive the lean years through which we are now passing. A good account of the more important of these is given by Dr. C. H. Desch in a brochure entitled "Substitute Materials in War and Peace", which he has written for the Royal Institute of International Affairs (Oxford University Press. 9*d*. net). Owing to war-time restrictions, very few details are given, but the bird's-eye view presented of substitutes for natural petrol, rubber, fibres, metals, and of the entirely new materials termed, somewhat erroneously, 'plastics', will convey to the layman all he needs to know for the appreciation of the present position in this very active field of inquiry.

Among the less well-known facts mentioned by Dr. Desch, the following may be cited: In the autumn of 1941, Germany was using producer-gas for running 150,000 lorries; many more were on order and also 20,000 new agricultural tractors with the same means of propulsion. In the United States, synthetic resins have become even scarcer than the aluminium they were designed to replace. An artificial fibre, made entirely from coal, limestone and chlorine, has been made in Germany since 1939; it is used for protective clothing, fishing nets and chemical filters. Some 10,000 tons of 'fodder yeast', first made on a large scale in Germany during 1914–18, was being produced at Regensburg in 1939. Nickel in the Axis countries has been largely replaced by chromium and molybdenum, obtained within occupied regions. There is no evidence that the quality of German aircraft is suffering in any way from lack of suitable alloy steels, but for steel-making there is probably a shortage of manganese, for which no satisfactory substitute is known.

In Great Britain much economy has been effected by reducing the number of steel specifications from 2,000–3,000 to 85, and further reduction is possible. Copper and 'stainless' steel for making resistant chemical plant have been economized by using mild steel with a surface-layer of the more valuable metal, rolled on to it during the manufacture of the plates. Difficulties have been encountered in finding a satisfactory substitute for tin in making tin-plate and for bearings. In the United States, plants are being constructed to produce annually 800,000 tons of synthetic rubber from petrol and 200,000 tons from alcohol, prepared from grain. Japan is said to be using her superabundance of rubber by distilling it to produce petrol. Of all substitutes now in use, synthetic resins are considered to have the greatest probability of survival, and as mineral resources gradually decline, as they inevitably must, greater use will be made of substitutes, and particularly of those which can be produced from the renewable raw materials provided by Nature.

Britain Needs a National Policy of Technical Education

THIS is the title of a pamphlet (price 6*d*.) published by Messrs. Pitman's and Son. It is a noteworthy addition to the many documents which have been issued to show the needs and possibilities of a reconstructed educational scheme, since it outlines strong arguments for the need for giving very special attention to the development of technical education. It reminds us that "Our education policy is being shaped now. Technical education is an integral and essential part of it, the importance of which must in no circumstances be overlooked or underestimated". No one will deny that, especially if it be realized that "There is no future of any consequence for Britain save as a highly industrialized nation". The pamphlet shows how technical education has been neglected in the past and underlines the disastrous policy which followed the Education Act of 1902 and separated secondary from technical education. Despite that neglect the magnificent work of the technical institutions since 1939 is made clear, and emphasis is laid on the fact that "the needs of peace will be as urgent and all embracing as those of war". Recommendations which will lead to the desired end are set out in detail. Many of them have already appeared in other documents dealing with educational reconstruction, but they cannot be too often repeated. Rather mysteriously the title page tells us only that the author is "A Student of the Future", but the pamphlet appears to be an expression of the views of the Association of Technical Institutions and the Association of Principals of Technical Institutions.

American Education and the War

IT is significant that the American magazine *School Life* has, for the duration of the War, been replaced by *Education for Victory*, "the official biweekly of the United States Office of Education Federal Security Agency". The aim of this interesting periodical is to spread information throughout the forty-eight States about war effort in the schools and colleges of each State. Prominence is given to a declaration of the National Education Association as to the spirit of school teaching in war-time. However it may be for the fighting forces, the emotions of hatred and revenge have no place in the schools, especially among the younger children. "The spiritual casualties of war will be great enough and lasting enough without any help from the teaching profession." Rather let the young people be taught a strong and positive love of freedom and fair play, and the strength of their opposition to slavery and injustice is assured. So *Education for Victory* tells of all that American schools and colleges are doing to help the war effort. Such activities as school gardening, and the securing of food for school lunches, appear to be carried out on an immense scale. The ever-pressing necessities of the war situation have directed closer attention than ever before to the problem of adequate nutrition. In still more direct ways than these, the schools are doing their share of effort. High-school students may now take the ground-school test of the Civil Aeronautics Administration. A few months ago, we are told, high-school students could only dream about aviation. Now tens of thousands of boys are studying pre-flight aeronautics, and 200 boys are actually learning to fly. *Wings for Victory* publishes also detailed information about what the higher educational institutions are doing for the War. Nearly five hundred of them have been approved tentatively, and subject to inspection will take allotted parts in war-training programmes. Obviously the normal course of scientific and technical education is being suspended, but on the other hand an immense stimulus is being given to forms of training that are destined to remain after hostilities have ceased.

Russian Interest in Mathematical Statistics

A CABLE from Prof. Alexander Schneiderman informs us that the centenary of Rothamsted Experimental Station was celebrated on July 21 at a meeting held in the Moscow Scientists' Club. Prof. Dmitri Prianishnikov, the 'father of Russian agricultural chemistry' and one of Timiriazev's closest collaborators, presented a historical review in which he indicated the part Rothamsted had performed in laying the foundations of chemistry applied to agriculture. Experimental fields in emulation of the classical trials of Lawes and Gilbert had been laid out in several countries; the Russian Institute for Research in Fertilizers has its own experimental field and conducts experiments at three hundred places in various soil zones of the Union.

Particular attention was given to Rothamsted's development of statistical methods, including the analysis of variance, in the design and interpretation of field experiments—a subject which hitherto has been noticed (by Russians) only by V. Romanovsky. Prof. Vassily Nemchinov read a paper on the significance of the work of the Rothamsted Statistical Department, founded in 1919 at the instigation of Sir John Russell. Prof. Nemchinov said that the idea of organizing a statistical department was characteristic of Rothamsted, as it involved collaboration between field workers, mathematicians, and pure biologists. A new branch of statistical theory had been developed, and had been very fruitful in estimating the reliability of results of both field and laboratory work.

Beit Memorial Fellowships for Medical Research

IN their annual report the trustees of the Beit Memorial Fellowships for Medical Research note the election this year again, as in 1942, of three past fellows to the fellowship of the Royal Society, namely, I. de Burgh Daly (fellow 1920–23); W. G. Penfield (1921); and S. Zuckerman (1934–37). Out of the twenty-five present fellows there are now sixteen seconded for whole-time war work. The following elections were made, with permission for each fellow to be seconded at any time for war duties: *4th Year Fellowships* (£500 a year): Dr. J. J. D. King, to continue his studies of dental caries and parodontal disease, at the Nutritional Laboratory of the Medical Research Council; P. C. Williams, to continue his studies of natural and synthetic œstrogens, at the Courtauld Institute of Biochemistry, Middlesex Hospital; *Junior Fellowships* (£400 a year): Margery E. M. Cutting, to study the physiological metabolism of organs in infancy, at the Department of Medicine, University of Cambridge; Dr. A. Kleczkowski, to study serological reactions in reference to size and shape of antigen and antibody particles, at Rothamsted Experimental Station, Hertfordshire; Dr. G. J. Popjak, for an experimental study of fatty and degenerative changes in the kidney, at St. Thomas's Hospital Medical School; Dr. Ethel G. Teece, to study the chemical structure of Gram-positive and negative micro-organisms and to develop antibacterial agents, at the Department of Chemistry, University of Birmingham.

Future of Analytical Chemistry

THE Council of the Society of Public Analysts and Other Analytical Chemists has had under consideration the desirability of the formation, within the Society, of groups or sections dealing with special subjects or branches of analytical chemistry. Many members of the Society have been concerned with the implications arising from the recent rapid development of analytical chemistry and the probable continuation of such development in the post-war period, and the need of some measure of federation and co-ordination of specialized branches of analytical chemistry was apparent. Since one of the objects for which the Society was established, as set forth in its memorandum of association, is "to encourage, assist and extend the knowledge and study of analytical chemistry", the Council believes that this purpose can be best achieved by the institution of groups within the framework of the constitution of the Society. Negotiations are already in progress with the Microchemical Club with a view to that body becoming a Microchemical Group of the Society, but the formation of other Groups also, as may be deemed desirable, within the Society will be encouraged, and proposals to this end will be submitted to a special meeting of the Society in the autumn.

National Institute of Social and Economic Research

THE annual report for 1942 of the National Institute of Social and Economic Research refers to the removal of the Institute to 2 Dean Trench Street, Westminster, where the new premises have permitted a thorough re-organization of the library. This has been re-classified and re-catalogued, and an accessions programme worked out to fill up the more serious gaps in books, periodicals and official publications. The Institute is prepared to make it available for reference to research workers in Government service who may wish to supplement the resources of their departmental libraries. Research work during the year was almost entirely a continuation or extension of programmes either under way or planned, but the first issue of the Register of Research in the Social Sciences, the new version of the summary of research in progress and in plan, was completed in December and has been circulated confidentially. The Saving and Spending Survey begun in 1940 was concluded in October, and the inquiry into National Health Insurance undertaken by Prof. H. Levy was sent to the press early this year. Dr. Baykov's study on the development of the Soviet economic system, which has taken the form of a thoroughly documented essay on the experience of planning in the U.S.S.R., was concluded by the end of the year. Dr. Singer completed in November a short descriptive study of standardized accountancy in Germany and Prof. Findlay Shirras brought to a close in the autumn the "Federal Finance Enquiry". Mr. A. Shenfield completed a report on "The Impact of War on Coventry: a Study in Industrial Dislocation", covering the war period up to the end of 1941.

Three inquiries, on national expenditure, output, and income, 1920–38, on the measurement of national income of selected Colonial territories, and on the burden of local taxation, which had already begun, were continued throughout the year and are being carried on in 1943. The second of these was originally concerned with Northern Rhodesia and Jamaica, but has now been extended to Nyasaland in view of the valuable data on that Colony which became available during the year. With regard to the third, a paper on the expenditure of county boroughs in England is now in the press and the full inquiry will be published under the title "Wealth and Poverty in Local Government", as there are insufficient data to permit a calculation of the local tax burden comparable with that made for the national tax survey in "The Burden of British Taxation". Of the inquiries upon which work only started in 1942, that into profit margins is the most significant. Other plans which came into operation during the year were Dr. R. R. Kuczynski's study of post-war population problems, and studies in aspects of commercial policy, directed by Dr. P. Barrett Whale. Two continuous projects were initiated in 1942: the observational study of the effects of the War on the credit policy and credit mechanisms of the City of London and the "Weekly Diary: Summary of Economic and Social Changes". It is intended to continue the former for the duration of the War, and a full-length descriptive and analytical summary is expected to result.

Vital Statistics of Canada

According to the twentieth annual report on vital statistics for 1940 and the preliminary annual report for 1941, both recently issued by the Canadian Bureau of Statistics, the population of the Dominion has increased in the last twenty years from 8,776,000 in 1921 to 11,443,000 in 1941. The largest populations were found in Quebec (3,329,000) and Ontario (3,765,000). Although the birth-rate for 1941 (22·3 per 1,000 population) showed a slight increase, the rate has fallen from an average of 24·1 in the quinquennium 1926–30 to 21·5 in 1940. The rate was highest in New Brunswick (25·9) and lowest in British Columbia (17·4). The stillbirth-rate in 1941 was 2·6 per cent of all births. As regards infant mortality the provisional figure for 1941 was 60 per 1,000 live births and the rate of 56 for 1940 was the lowest recorded. The maternal mortality-rate for 1940 was 4·0 per 1,000 births and that for 1941 was 3·5. The marriage-rate showed a progressive increase from 7·3 per 1,000 population in the period 1926–30 to 10·8 in 1940 and 10·7 in 1941. The general death-rate was 9·6 per 1,000, the lowest rate being found in Saskatchewan and in Alberta.

Sources of Engineering Information

The fifth number of the ASLIB War-time Guides to British Sources of Specialised Information (March 1943) deals with engineering other than electrical. These are listed under Government departments; professional, research and trade organizations; and educational organizations and technical educational organizations. The list of Government departments is not comprehensive, but is confined to sources of information still usually accessible. All references to industrial firms have been omitted. Electrical engineering and telecommunications are covered by Guide No. 3. An additional section lists a number of organizations dealing with fuel, raw materials, transport, etc., which while not directly related to engineering are concerned with materials and aspects of work of immediate interest to engineers. The section devoted to periodicals lists separately those printing abstracts or lists of references; periodicals issued by professional and industrial organizations; other trade and technical periodicals; selected periodicals relating to auxiliary interests; engineering annuals; and annuals dealing with auxiliary interests.

Recent Earthquakes

The U.S. Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the epicentres of two recent earthquakes. The first of these was on June 8 at about 20h. 42·2m. U.T. and occurred near latitude 19° N., longitude 116° E. This is in the South China Sea, west of Luzon in the Philippine Islands. The second was on June 9 at about 3h. 6·7m. U.T. and had its epicentre near latitude 9° N., longitude 120° E., which is in the Sulu Sea north-east of Borneo. On the morning of Friday, July 16, a strong earthquake was felt throughout the Island of Jamaica. The epicentre was some ninety miles from Kingston in the Balaclava district, where some damage was done to property though there are no reports of any loss of life.

Announcements

The Association of Scientific Workers (West Midland Area) has arranged an open conference on "Science under Fascism and Democracy", to be held at the Town Hall, Birmingham, on August 22 at 3 p.m. The Lord Mayor of Birmingham (Councillor W. S. Lewis) will open the conference, and the chair will be taken by Prof. M. L. E. Oliphant. Among the speakers who will deal with the sharp contrast in the approach to science and its applications, and also the treatment of scientific workers, in Democratic and Fascist countries, are Prof. J. B. S. Haldane (Great Britain), Dr. J. H. Hildebrand (United States), P. H. Yap (China), M. Fournier (France), Dr. A. van Anrooy (Holland), Dr. B. Schober (Czechoslovakia), Dr. A. Fischer (Austria), and Dr. J. G. Siebert (Germany). In the evening following the conference, films will be shown depicting scientific activities in many countries.

The fifth supplement to the "British Pharmaceutical Codex" contains new monographs describing the insecticides derris and lonchocarpus, and new regulations which are introduced because of the shortage of rubber and quinine. Where the "Codex" insists on rubber, the supplement allows other materials to be used, and where the "Codex" includes quinine the supplement omits it except in the cases where it is considered essential. This supplement also includes a cumulative index to all the five supplements which have been issued.

The New York Academy of Medicine, in co-operation with the State Department of Health, the City Department of Health and six of the leading voluntary organizations of maternal welfare and child health, recently celebrated the hundredth anniversary of the publication by Oliver Wendell Holmes of the paper entitled "The Contagiousness of Puerperal Fever".

Erratum. In the letter entitled "Production of Ion Clusters by X-Rays" (Nature, June 19), sixth line from bottom of first column, p. 698, for "$B_Z = 11{\cdot}2$ ev." read "$B_Z = 11{\cdot}2\ Z$ ev.".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

War-time Growth of Schoolboys

THE rationing and restriction of many of our common foodstuffs has prevented the free choice of food to which we were all of us accustomed before the War, but it has handicapped some of the community much more than others. The public schools have had a difficult time because boys of 14–18 require more total food than the average holder of a ration book, yet the schools have no means of obtaining meals for their boys outside the ordinary rations. The question therefore has arisen as to whether this has made any difference to the boys' rate of growth. Are public school boys now as tall and heavy as they were before the War? The pre-war and war-time weight and height records of boys at two public schools have been submitted to statistical analysis. Both schools take a serious interest in the way their boys are fed.

GROUP *A* (BOYS AGED 14–15 YEARS).

Year	Average weight in January of each year. (lb.)	Average increment during the year. (lb.)	Average height in January of each year. (in.)	Average increment during the year. (in.)
1939	115·5	12·9	64·9	2·4
1940	113·9	12·0	64·4	2·5
1941	116·9	12·8	65·2	2·4
1942	116·4	12·8	65·3	2·1
1943	113·8		64·0	

GROUP *B* (BOYS AGED 15–16 YEARS).

Year	Average weight in January of each year. (lb.)	Average increment during the year. (lb.)	Average height in January of each year. (in.)	Average increment during the year. (in.)
1939	123·8	11·6	66·8	2·0
1940	125·6	10·3	67·1	1·7
1941	126·5	10·3	67·1	1·9
1942	128·0	10·0	67·5	1·7
1943	129·2		67·4	

The rate of growth during the year January 1939–40 has been compared with the rates of growth during the three following years. The boys were divided into two age-groups, *A* and *B*. Group *A* comprised all boys who became fifteen during the course of each year of investigation, and group *B* all boys who became sixteen during each year.

Very similar results were obtained at both schools and average results for one school are shown in the accompanying tables. At this school there were about a hundred boys in each age-group in each of the years 1939–43. There has been no significant decrease in the height and weight of these boys during the past three years; the 15–16 year-old boys are in fact taller and heavier now than were boys of a corresponding age before any food restrictions were imposed. Hence we may conclude that, given reasonably good catering and management, the rationing system should not have interfered with schoolboys' growth. This speaks well for the system of rationing, or the brains behind it; but it may be pointed out that if no outside sources of food are available, the catering must be good to make the present rations the basis of an adequate diet for a group of healthy young men or boys.

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R. A. MCCANCE.
E. M. WIDDOWSON.

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July 17.

Radioactivity and the Completion of the Periodic System

IN connexion with the article by Prof. F. A. Paneth[1] in NATURE of May 23, 1942, I would like to direct attention to the fact that the systematics of isotopes acquires a more simple and logical form if, besides the usual formation of nuclei by addition of a neutron (${}_0^1n$) and a proton (${}_1^1p$), we assume the possibility of the formation of new nuclei by addition of a hypothetical particle (${}_{-1}^{1}a$) of unit mass and charge equal to $-e$, which may be called the aproton-type formation of nuclei.

In a recent paper[2] I have shown that, if all isotopes are plotted on the graph (Z, A), some regularities in the position of stable nuclei may be noticed. These regularities may be considered as a consequence of the existence of the following scheme in the sequence of addition of elementary particles in the process of formation of new nuclei:

$$\left.\begin{array}{l}\text{(1) From hydrogen to oxygen } n\rightarrow p\rightarrow n\rightarrow p\rightarrow\ldots\\ \text{(2) From oxygen to titanium } 2n\rightarrow 2p\rightarrow 2n\rightarrow\ldots\\ \text{(3) From titanium to uranium } (2n \text{ or } 4n)\rightarrow\\ \qquad\qquad\rightarrow(2p(a) \text{ or } 4p(a))\ldots\end{array}\right\}\quad(1)$$

where n, $2n$, $4n$ . . . denote the addition of one, two, four . . . neutrons one after another without interruption; p denotes the addition of a proton; $2p(a)$, $4p(a)$ the addition of two or four protons one after another, the last of which may or may not be replaced by an aproton.

Fig. 1 shows a part of the graph (Z, A), namely, from $Z = 78$ to $Z = 94$. Stable isotopes are denoted by crosses, β-active isotopes by circles, and stable isotopes not yet found, but expected according to the above scheme (1), by dots. As this graph shows, all known stable isotopes in this range, without exception, agree with the scheme. On the other

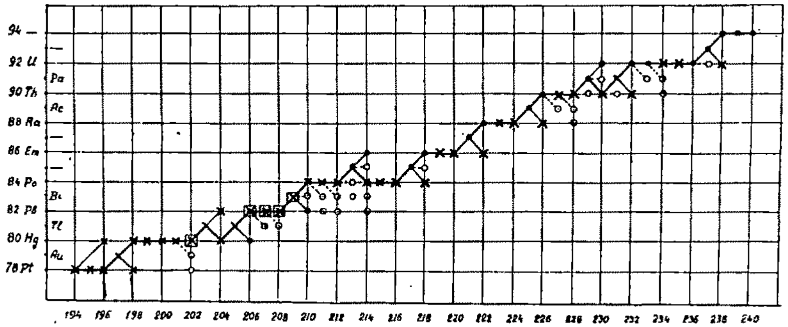

Fig. 1. SYSTEMATICS OF ISOTOPES.

✕ known stable and α-active isotopes.
● expected stable and α-active isotopes.
○ unstable, β-active isotopes.

hand, all nuclei which do not follow the scheme (1) are unstable, that is, β-active. For example, $^{40}_{19}$K is formed from $^{39}_{19}$K by addition of a neutron (instead of the expected addition of a proton); it does not follow the scheme and is therefore unstable. $^{40}_{19}$K, being transformed to the permitted configuration, $^{40}_{20}$Ca, emits β-rays (T approx. 10^8 years).

Artificially obtained $^{198}_{79}$Au likewise (see Fig. 1) is formed by the addition of a neutron, whereas after the first proton ($^{196}_{78}\text{Pt} + ^{1}_{1}p = ^{197}_{79}\text{Au}$) a second proton was to be expected. This nucleus is again unstable (β-active) and disintegrates with a period T of 2·7 days.

After the addition of the first proton, there are two possibilities of a further complication of nuclei: either a proton ($A = +1$; $Z = +1$) or an aproton ($A = +1$; $Z = -1$) may be added. As a result, two isobars with the same A, but differing in Z ($\Delta Z = 2$), may be formed in accordance with Mattauch's rule.

For example (see Fig. 1):

$$^{202}_{80}\text{Hg} + ^{1}_{1}p = ^{203}_{81}\text{Tl}; \quad \begin{cases} ^{203}_{81}\text{Tl} + ^{1}_{1}p = ^{204}_{82}\text{Pb}. \\ ^{203}_{81}\text{Tl} + ^{1}_{-1}a = ^{204}_{80}\text{Hg}. \end{cases} \qquad (2)$$

According to scheme (1) above for elements with Z greater than 7, after the addition of the first proton, either a second proton or an aproton, but not a neutron, must follow. The result is that elements with odd atomic numbers may have either *one* isotope, for example, $^{197}_{79}$Au, or, in the case of addition of an aproton, *two* isotopes, for example, $^{203}_{81}$Tl and $^{205}_{81}$Tl (Aston's rule).

The introduction of a new type of particle taking part in the formation of nuclei, namely, the aproton, may be justified also by the fact that new regularities in the nuclear properties may thus be discovered. For example, the addition of a proton or an aproton is followed by a spin change $\frac{3}{2}\hbar$, and the addition of a neutron by a change $\frac{1}{2}\hbar$; the addition of an aproton results in the disappearance of the electric quadruple moment of nuclei, for example, $^{69}_{31}$Ga, $^{75}_{33}$As, $^{115}_{79}$In, etc.; when the position of a nucleus falls in the (Z, A) graph between two stable isobars, with $\Delta Z = 2$, formed by addition of a proton and an aproton to the next isotope with lower mass, a branched ± β-activity is observed ($^{64}_{29}$Cu, $^{76}_{33}$As, $^{104}_{75}$Rh).

Following L. Turner[3], it may be interesting to make a suggestion (Fig. 1) concerning the genealogy of isotopes of heavy elements with the help of scheme 1 above.

All heavy elements may be arranged in five radioactive families, one of which is presented on Fig. 2. This family is especially remarkable because all its members, except the final product $^{209}_{83}$Bi, have vanished.

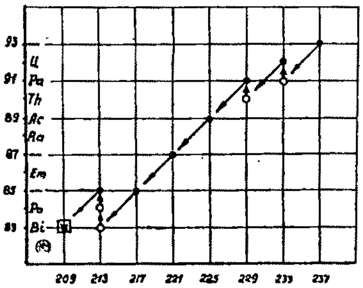

Fig. 2. EXTINCT RADIOACTIVE BISMUTH FAMILY.
X α-active isotopes.
O β-active isotopes.

Among the members of this family, the following isotopes of elements, according to Mendeléeff's table, should be found:

$$\begin{aligned} Z &= 85 \quad A = 213 \text{ and } 217; \\ Z &= 87 \quad A = 221; \\ Z &= 89 \quad A = 225. \end{aligned} \qquad (3)$$

As recently shown by Corson and Mackenzie[4], element $Z = 85$ can be obtained by bombardment of bismuth with α-particles. This is obviously the last element but one in the extinct bismuth family and it is α-active ($T = 7{\cdot}5$ h.). Both Paneth[5] and Mlle. Perey[6] have discovered α-activity in actinium ($Z = 89$) and supposed that $^{227}_{89}$Ac possesses besides β- also α-activity.

As may be gathered from Fig. 1, $^{227}_{89}$Ac cannot be a stable isotope and must therefore emit β-rays. At the same time, actinium must have another isotope, $^{225}_{89}$Ac (see Fig. 1), which is stable against β-decay (it follows scheme 1) and may show α-activity. This isotope must be another member of the extinct bismuth family.

LEO PONISOVSKY.

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Role of Acetylcholine and Vitamin B_1 in Nervous Excitation

AT the cut end of a peripheral nerve acetylcholine[1] and vitamin B_1[2] are set free and diffuse into the bathing fluid at rest and during excitation. The amount set free during excitation is considerably greater than during rest. The production of these and maybe other substances at the cut end of a stimulated nerve can be made visible with the aid of the *Schlieren* method of Toepler[3]. If short periods of stimulation are interchanged with periods of rest, the substances diffusing out are seen as little outbursts of 'clouds' near the cut end of the nerve, showing that it is mainly the excited state which leads to the production of these substances. Their appearance might have been due to a decrease in permeability during excitation and not to an actual formation. This possibility is ruled out by the fact that freezing stimulated nerves with liquid air, making use of the principle of the Doppler effect in order to accumulate the excitation waves, leads to an actual increase of these substances in extracts obtained from the frozen and minced nerve. In the excited nerve (sciatic of Hungarian Esculenta) an increase of 0·1 μgm. acetylcholine per gm. nerve has been measured with great regularity in fifty independent experiments, with an average error of ± 0·01 μgm. The ratio of acetylcholine content in stimulated and unstimulated nerve is 1·6[4]. The extracts of stimulated nerves show at the same time a great increase in vitamin B_1 content. This increase has been demonstrated with six independent methods (increase of the response of a leech-preparation to acetylcholine[5], a new polarographic method[6], Flagellatæ-test[2], Phycomyces-test[7], bradycardia-test of the rat[8], thiochrome-reaction[9]) and amounts to 2 μgm. per gram nerve.

Incubation of nerve extracts[10], or of small nerve pieces[11], with oxygen and glucose leads to a formation of acetylcholine. The increase is larger in bound than in free acetylcholine[10]. Bringing these facts in relation to results obtained with brain-preparations[12], it is probable that the potassium ion has a direct influence on the equilibrium between bound and free acetylcholine in nerve and that the presence of pyruvate and vitamin B_1–co-carboxylase is necessary for the formation of an acetylcholine reserve upon which the nerve can draw in case of prolonged stimulation. If nerve preparations are treated with ferricyanide and alkali, according to a new histological technique[13], the fluorescence-microscope reveals that the thiochrome, formed from the vitamin B_1–co-carboxylase system in nerve, is located in the myelin-sheath. The axon shows practically no fluorescence due to thiochrome. Measurements of the repartition of co-carboxylase, determined by the method of Lohmann and Schuster in fibres of the squid, show an accumulation in the myelin-sheath, and cholinesterase seems to be located almost only in the sheath[14]. The myelin-sheath therefore must be regarded as a storage battery in which acetylcholine-formation from the phosphatide- and the glucose-pyruvate-breakdown take place. The decrease of insoluble phosphate and the increase of acid-soluble phosphate during excitation of peripheral nerve[15] points out that the phosphate set free with the liberation of choline from phosphatides is taken up by acceptor-systems like creatin, adenosin- or vitamin B_1, which play an important part in the maintenance of the resting potential of nerve[16].

Single nerve-fibre preparations are highly sensitive towards irradiation with *short*-wave ultra-violet[17]. Wave-lengths of more than 290 mμ have no effect at all. But if the ultra-violet light (all wave-lengths) is filtered through a quartz-cuvette containing vitamin B_1 there is also no effect at all. The change in excitability with irradiation is twofold. With small doses there is a regular and considerable decrease of the threshold. Larger doses lead to an irreversible effect with increase of threshold, loss of excitability and destruction. Vitamin B_1 is very sensitive to ultra-violet of less than 290 mμ with a maximum of photochemical decomposition at 255 mμ[18] (pH = 7). Tryptophane and other filters with different absorption properties have not the same protective action towards the photochemical action of light on preparations of single nerves. Although all nucleotides have similar absorption spectra[19] it seems that the photodynamic action of short ultra-violet on single nerve fibres is mainly due to photochemical decomposition of vitamin B_1 and is comparable with the changes in excitability connected with avitaminosis.

Vitamin B_1 as a phosphate donator and acceptor system with its co-carboxylase activity in the diphosphorylated state is an essential factor in the excitation process of peripheral nerve. Acetylcholine formation and mobilization of energy seems to be connected with co-carboxylase activity during or shortly following excitation. 'Recharging' must be the function of the system, and it is therefore not surprising that in polarization the vitamin B_1 content is increased near the anode[13] and that photochemical destruction or avitaminosis has the same effect as cathodic-polarization on excitability.

Full details will be presented elsewhere. I am indebted to the Rockefeller Foundation for grants in aid of this work.

A. v. MURALT.

Hallerianum,
Berne.
May 30.

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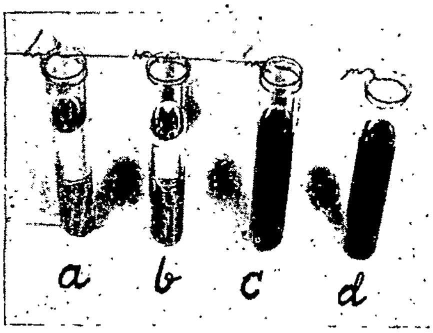
Promotion of the Corrosion of Iron in Alkaline Solutions by Zinc and Aluminium

THE preventive action of zinc on the corrosion of iron is well known and has been practically applied for a long time (galvanizing of iron). Also aluminium has been tried for the same purpose. In special cases, however, small amounts of zinc or aluminium may have a quite opposite action. For example, it has long been known that iron which has been passivated in strong nitric acid is activated by being touched with a piece of zinc, after which it is readily corroded. It has now been found that in certain alkaline solutions somewhat similar reactions may occur.

In two earlier communications I have published some facts about the passivity and corrosion of iron in strongly alkaline solutions in the presence of certain organic reagents[1]. By further experiments, partly with other reagents and sometimes extending over longer periods of time, the earlier observations were confirmed and completed. In many cases there was found a well-defined difference between passive and active iron in the same alkaline solution. With passive iron the attack is very slight, if any; the metal remains bright and does not give any coloration to the solution. Active iron corrodes more or less rapidly, its surface darkens and, in some cases, it causes a coloration of the solution. With special reagents this coloration is very intense and can be observed immediately after the activation of the metal. In this case the reagent may be considered as a kind of indicator (compare ref. 1). In other cases the first signs of corrosion are not found until several days or even weeks have passed. The change from the passive to the active state is affected by a cathodic action which causes a reduction of the protecting oxide layer on the iron. To produce this action only small amounts of zinc or aluminium need be in contact with the iron. When the less noble metal is later on removed or dissolved, the iron remains in the active state.

The experiments on which these statements are based were carried out in different ways. It was shown, for example, that a sample of pure iron nails covered with an alkaline reagent solution was preserved rather well during 1–2 months, whereas distinct signs of corrosion were found in the same solution if a few galvanized nails also were present. Another way of demonstrating the effect is shown by the accompanying figure. The reagent solution was 3·1 *N*. sodium hydroxide containing 3·6 gm. of nitrosoguanidine per litre. The test-pieces were soft, polished 0·8 mm. iron wire, spiral-wound. In *a* and *b* the spirals were wound round a glass rod, in *c* and *d* round a rough aluminium rod and abruptly pulled off. In the latter case small amounts of aluminium stuck on the iron and caused activation in the solution. The photograph was taken six hours after the beginning of the experiment.



In most cases the alkali used was sodium hydroxide in concentrations varying between 2 *N*. and 3·5 *N*. Among the reagents used may be mentioned dithio-oxamide, nitrosoguanidine (indicators), tartrate and citrate (no immediate change is observed). Self-activation may occur with dithio-oxamide. A few experiments even showed an effect in pure alkali without a reagent.

From what has been said above, it is obvious that the corrosion conditions of iron in alkaline solutions deserve further examination. More details of the experiments already made will be published later. The investigations will be continued should conditions permit.

The main part of this work was carried out at the Corrosion Laboratory of the late Prof. W. Palmer at the Nobel Institute, Stockholm.

GUSTAV NILSSON.

Stockholm.
June 25.

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Physiology of Colour Vision

ON Mr. Willmer's[1] theory of colour vision, three sets of nerve impulses reach the brain, one set from the rods only, another from the cones only (which on his theory are all alike) and another from the flat bipolar cells which connect together some of the rods and cones.

On this theory, since the flat bipolar cells are connected to rods and cones, the frequency of impulses, f_m, from the flat bipolar cells is dependent only on their constitution, and the frequencies, f_r and f_c, of the impulses from the rods and cones. Hence f_m is not an independent variable—there are only two independent variables, f_r and f_c.

Now the colour manifold of the normal individual, or *tri*chromat, is clearly *three* dimensional—colour sensations have the *three* independent qualities of colour, intensity and saturation—and therefore need *three* independent variables to represent them completely. It is for this reason that, for example, the Young-Helmholtz theory has *three* fundamental sensations, or, as another example, that every colour can be perfectly matched in all its qualities by means of a unique mixture of the light of *three* standard wave-lengths, or, as a last example, that Clerk Maxwell represented the colour manifold by a *three*-dimensional solid, the pyramid with the colour triangle as its base.

On Mr. Willmer's theory, which has only two independent variables, every conceivable colour sensation would have only two independent qualities, for example, colour and brightness or a combination of colour and saturation and a combination of saturation and brightness. This is obviously untrue. Also, on this theory, every conceivable colour could be matched in all its qualities against a mixture of suitable intensities of any two monochromatic lights. (The intensities of one or other of the monochromatic lights might, of course, be negative, that is, one or other of the monochromatic lights might have to be added to the colour which it was required to match.) This also is well known to be untrue, except in the case of the colour-blind. When Prof. Hartridge[2] in his criticism of Mr. Willmer's theory points out that a mixture of red and violet cannot produce every colour of the spectrum, he really is considering one particular case of the more general criticism outlined above.

A. H. S. HOLBOURN.

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[1] NATURE, **151**, 213 and 632 (1943).

[2] NATURE, **151**, 422 (1943).

ACCORDING to Mr. Willmer's original hypothesis, a simultaneous stimulation of the rod elements and cone elements produces the various shades of green, yellow and orange which are found in the visible spectrum. One of the difficulties of this theory is to explain the recognition of violet, mauve and purple, and the way these shades are differentiated from the above-mentioned spectrum colours. Mr. Willmer's recent hypothesis has been designed to overcome this and other difficulties of the previous one. According to this, strong stimulation of the rods and cones simultaneously causes an appreciation of green, yellow or orange, whereas the weak stimulation of the same receptors causes an appreciation of violet, mauve and crimson.

This modification of the hypothesis was tested in the following manner. Two colour filters were selected, one transmitting brilliant green and the other transmitting brilliant purple. Behind both were mounted a series of neutral tint gelatine films so that the intensity of light transmitted by both the above filters was reduced in intensity, the first step being 1/10 of the full transmission, the next 1/100, the next 1/1000 and so on. According to Mr. Willmer's theory, we should expect that the green filter would, if sufficiently decreased in intensity, change to purple or violet. Vice versa, we should expect from this theory that the purple light transmitted by the other filter would, if sufficiently increased in intensity, change in colour to green. On testing both these eductions experimentally neither was found to be he case. The green remained green at all intensities nd the same applied to the violet.

The above experiments do not fit in with Mr. Villmer's theory.

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H. HARTRIDGE.

FOR many years it has been taught with more or ess dogma that colour vision depends upon three ypes of cones. In the mammalian retina no such ifferentiation of the cones has been made with any egree of certainty. It is true that there are some bservations which have been regarded as favouring uch a view, but there are just as many which can e used as arguments against it.

For this reason it seemed to be worth while to aise again the question as to whether in fact it is ot possible to explain colour vision in terms of the ctivities of rods and cones and their now more rmly established neural connexions. As an attempt 1 this direction the hypothesis somewhat inadequately utlined in two previous articles[1] suggested a possible asis for colour vision resting on the properties of ods and cones only. Essentially the hypothesis uggested that the ratio of the responses elicited from he rods and cones might determine the hue, some unction of their difference the saturation, and the bsolute frequency of the cone impulses, or perhaps ne sum of the rod and cone frequencies, might egister the intensity.

Prof. Hartridge[2], Dr. Craik[3] and Mr. Holbourn above) have all raised fundamentally the same bjection, and it would be idle to deny that it is an extremely serious one to the hypothesis in its present orm. Whether, on the other hand, it necessarily invalidates the hypothesis as a whole can only be judged fter it has been possible to review in more detail the rguments both for and against the hypothesis. uch a review is in course of preparation.

Physiological Laboratory,
Cambridge.

E. N. WILLMER.

NATURE, 151, 213, 632 (1943).

NATURE, 151, 422 (1943).

NATURE, 151, 727 (1943).

our Years of Planned Feeding in Great Britain

ONE paragraph in the article on the above subject[1] somewhat misleading. Dr. Pyke, discussing the rotein requirements of the human body, states that he normal consumption of bread and potatoes provides ufficient protein for bodily needs. Unfortunately, as r. Pyke is no doubt himself aware, the protein of read and potatoes (and of most cereals and pulses) , in itself, inadequate for the building of human rotein since it is deficient in some of the essential mino acids, notably tyrosine, lysine and tryptohane, which the human body is, of course, unable o synthesize.

52 Beechwood Gardens,
Slough, Bucks.
June 30.

ALAN BLAINEY.

NATURE, 151, 658 (1943).

As Mr. Alan Blainey inferred, I purposely refrained from discussing the problem of requirements of first-class protein in my article.

The assessment of requirements of first-class protein is extremely difficult. While on one hand it would be dangerous for the national consumption of animal protein to fall to a figure lower than, say, 25 gm. daily, there is on the other hand a good deal of evidence that very much smaller amounts of animal protein when eaten mixed with protein of a lower biological value substantially raise the biological value of the whole. Thus, quite small amounts, say, of dried egg, mixed with large amounts of cereal protein in a made dish, would possess a biological value little lower than that of egg protein itself. Similarly, it has been found that the biological value of the protein in a complete mixed day's diet of a normal character is practically as high as the value of the first-class protein in it, which may make up only a small fraction of the total amount.

Besides the difficulties of making a scientific assessment of the requirements of animal protein needed per head of the population, there are the added difficulties of national prejudice. For example, men doing heavy muscular work feel that they have increased need for meat, although it has never been proved that muscular work increases the requirements of animal protein.

In my article I did not mean to assume that protein requirements could be met from vegetable foods alone. Although the national diet must inevitably be restricted in war-time, there is little likelihood that all sources of animal protein can ever become completely unavailable. It is true that the adequacy of supplies of first-class protein must be a matter for close scrutiny.

This matter, as I may have indicated here, was, in my opinion, too complex for discussion in the general type of article which was published in NATURE of June 12. Nevertheless, the fact remains that the increased use of foods such as potatoes and flour of high extraction in the national diet ensures an adequate proportion of *total* protein.

MAGNUS PYKE.

Ministry of Food.
July 6.

Future of Technical Colleges

THE letter by Messrs. Barrer and Andrews[1] from the Technical College, Bradford, will surely be as great and as distressing a surprise to many as it has been to me. The admirable work of technical colleges plays so great a part in the nation's welfare one would indeed hope they would stand proudly upright on their own feet rather than dissipate energies in screw-jacking themselves painfully to some self-determined level they choose to regard as of "university rank and status". Cannot they take heart and be persuaded to see themselves as others see them ? When I was with good colleagues during the War of 1914-18, in the Manchester College of Technology, we found it good and sufficient to be of a great institution. Many close friends who have worked or do work in technical colleges tell me, however, that an undue amount of energy is expended in preparing a very small nucleus of students for external degrees of a university, and thereby is diminished the potential for the dominant duties which the technical college has to perform : if this be so, it is a great pity. Therefore I was extremely glad to see Sir Lawrence Bragg's Committee of the Institute of Physics recommended that "it should not be a *primary* function of a technical college to educate students for External University Degrees".

All external examinations are abomination and an evil rot in an educational system. The extent of their evil is stated with masterly directness by A. N. Whitehead on pp. 7 and 8 of his essay "The Aims of Education", and I urge Messrs. Barrer and Andrews to read it. Surely all teachers will hail joyfully the statement from the Institute of Physics and use it as a heavy missile to hurl at that horrid monster, the external examination, and at all who nourish it.

The suggestion that the Committee's proposals deny "the right of the technical college to give the highest training to the young technologist" is a *non sequitur*. The young technologist will demand, and on the whole get, the highest training his instructors are capable of providing. Students realize they cannot explain to their teachers what good instruction consists of, but youthful eyes perceive unerringly what instruction is sincere and what is not.

We are told that "Even major technical colleges have suffered too much in the past from being maintained as subordinate institutions. From this position, the only means of escape has been to become university colleges, . . ." We are not told by whom they have been kept subordinate, and so painfully as to need escape. Section 333 of the Report on Education by the Bradford I.L.P. Commission states that "The universities, although their work is of vital importance to the community, lie a little outside the main current of modern life. They deal largely with specialist topics: they have grown up gradually and possess a vitality, a principle of development of their own". Accepting, then, this statement, it would seem that if major or even minor technical colleges have ever been so craven as to escape thus from "the main current of modern life", at least they happen to have found sanctuary where they can learn "a principle of development of their own", and some day may feel brave enough to return to the world and their duties.

Let us hope we shall hear no more of climbing ladders in a world of rank and status, ever fearful of being de-ranked, but devote all our thoughts to ascending the steady gradient in the kingdom of the mind, a task which brings peace and contentment to all men who will consistently lift up their eyes and look outwards.

E. B. Moullin.

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Company, Limited,
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[1] Nature, 152, 80 (1943).

Science, Christianity and Truth

Errors such as Dr. Huxley denounces in the first part of his letter[1] probably arise from the confusion of two distinct, and indeed contrary, doctrines. One is that moral values are as irrelevant to science as the rules of chess are to the sport of angling; the other is that science leads to the positive conclusion that moral 'values' are invalid. Each of these doctrines has been supported by some men of science especially among chemists and physicists; but, as Dr. Huxley says, specialists in evolution, which Mr. Hardwick considers to be the basis of his confused doctrine, have usually rejected both.

A few years ago, it seemed likely that religious apologists would adopt the first doctrine, and would therefore cease to write books about science and religion. Apparently they have had difficulty in persuading people that the study of facts, now everywhere recognized as essential to decisions about means, has no bearing upon ends. If that is their reason, those who are less rash than Mr. Hardwick will scarcely adopt the second doctrine. The only alternative open to them seems to be a return to natural theology, namely, the doctrine that science does throw light on metaphysics and ethics, and that this light is favourable to official Christianity. Some of them must surely be regretting that their grandfathers, in a panic about evolution, killed Paley so efficiently that not even the eloquence of an Eddington can revive him.

Norman R. Campbell.

21 Carlton Hill,
London, N.W.8.
July 20.

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[1] Nature, 152, 79 (1943).

While I should like very much to agree with the point of view put forward by Dr. Julian Huxley in his letter[1] under the above title, I feel his attitude is almost as unscientific as that of the Rev. Hardwick whom he criticizes.

(1) Dr. Huxley must know that in the book[2] to which he refers strong arguments are given against the view that "evolution . . . provides the only external yardstick or standard by which to measure the correctness of our social principles and our ethical judgements". Yet in his letter he makes no attempt to refute such arguments, nor does he even refer to their existence.

(2) I agree that the second quotation which Dr. Huxley gives from the Rev. Hardwick's review need not worry men of science at all; but surely the first is not so extraordinary as Dr. Huxley supposes. There is as much disagreement among men of science, I think, about the best form of social organization as among non-scientists. There are many German and Italian men of science who are Nazis and Fascists, and there are many British and American men of science who are not Communists. If the ethics of society can be settled by an appeal to evolution, it would be interesting to know why such disagreement exists. The obvious explanation is that such disagreement is not a scientific one, but due to 'fads' or 'prejudices'. Dr. Huxley says that this is unscientific, but it seems to me to be unscientific of him to say so, unless a very good reason can be produced why so many men of science are acting unscientifically.

C. D. Hardie.

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July 20.

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[1] Nature, 152, 79 (1943).

[2] Waddington, C. H., "Science and Ethics" (London, 1942).

INVESTIGATIONS INTO SAL AND TEAK

INDIAN Forest Bulletin No. 115, Utilisation (For. Res. Inst. Dehra Dun, 1942), discusses a fascinating problem in connexion with many tropical timbers which has puzzled possibly generations of forest officers, to wit, how to distinguish between the sapwood and the heartwood. This title, with the addition of the words sal (*Shorea robusta*), is the subject of the bulletin. The author in charge of the wood technology section of the Institute sums up his investigations—it is not always safe to assume that the true sapwood and heartwood of sal can be distinguished merely by their colour. The best method is to find out whether tyloses are present or not in the pore cavities. When tyloses are present the timber is heartwood, and when absent, sapwood. The colour, whether pale reddish-brown or dark reddish-brown, is immaterial and no true indication.

In Bulletin No. 113, Utilisation (1942), from the Institute is an interim report on "The Relation between Rate of Growth and Strength of Natural and Plantation Teak". "How fast should trees be grown ?" inquires the author, and adds, "it is a question forest officers often have to ask themselves, and especially those in charge of plantations". Compared with India's vast forests her artificial plantations, important though they are in their several localities, are a mere grain of sand in the great whole. But this question needs consideration in India, and in tropical countries generally, just as much as it will be found to require careful study in Britain in connexion with the afforestation work of the Forestry Commission ; based as so much of it is on exotic conifers.

The author of the bulletin is merely repeating a forestry platitude when he says that the chief aim (one of the chief, he remarks) of most forest plantations grown for timber is to produce high-quality timber in the shortest possible time. Marketable timber, omitting the 'high quality', would be a truer definition of modern-day practice. The first plantation formed of teak under British action was the famous Nilumbur (or Conolly) Teak Plantation, the first compartment being planted in 1843. Such was the success of this fortunately and fortuitously situated plantation (on the Beypore river some forty-eight miles distant from Calicut, west coast of Madras) hat it has been copied elsewhere in India and Burma with varying success, and also in Africa and other parts of the tropical world. In many cases the young planted teak plants have shown an abnormally ast height growth in early years; in other words, the growth in a few years of a product which could ften find a ready market long before it came to timber size.

The problem which is discussed in the bulletin s the question of the effect of the rapid growth on the strength of the product produced, for there are obvious limits ; it is just the question of what the optimum rate of growth is for different species which emains an unknown factor. It is an accepted dictum that very fast or very slow (the latter with exceptions) grown timber is usually deficient in strength. On the subject of teak and the information gained, the author states that the existing data have been analysed and the record given in the bulletin. From the limited data available (in spite of the fact that t is just a century since Conolly commenced the formation of the Nilumbur plantation), says the author, "it will be seen that a rate of growth of about 5–6 rings per inch has been found to produce the strongest timber, and a rate of growth faster than about 4 rings per inch produces very weak timber". It is also added that plantation teak, although fast grown, is in no way inferior to natural teak so far as its strength properties are concerned. It is worth while mentioning that the warning is given that the data available are still insufficient, except "as an interesting indication" : and, it should be added, a dangerous one upon which to build up large plantations of rapid-growing exotics, wherever practised in the Empire.

THE BRITISH WAY

By LIEUT. T. H. HAWKINS

WAR makes strange situations; and no war can have thrown up a situation more strange than the one that the appearance of the Oxford Pamphlets on Home Affairs represents*. Instead of indulging their well-established habit of grousing at all things British, our fellow-countrymen are now learning to be not ashamed of expressing their deeper and more real feelings ; some of the bolder individuals are even talking with unconcealed pride of the traditions and institutions of Great Britain.

The publishers of these booklets have sensed this change in the national mood and have launched a series which should prove as useful and informative as the more familiar "Oxford Pamphlets on World Affairs". The new series has been prepared on lines similar to the World Affairs Pamphlets and offers short summaries of various sides of life and living in Great Britain. They bear striking resemblances to the series of booklets called "The British Way and Purpose" which have been issued monthly to all units of the British Army since last November and should get a reception as favourable as the latter have done with the troops.

(1) Mr. McCallum's book describes the institutions and methods by which Britain is governed, how parliamentary government has grown side by side with the monarchy, the relations between the Crown, Ministers, Parliament and people and how the party system works in effecting the will of the electors. But while men of Britain are intensely proud of their forms of government, they are only too conscious of the deficiencies. Mr. McCallum would have offered a greater contribution to the future of democratic government by discussing some of the defects of our governmental institutions and their possible remedies.

(2) The pamphlet written by the member of Parliament for Keighley is a miniature guide for the newspaper reader. It explains the difference between the various kinds of reading-matter in a newspaper ; the "sacred" facts and the "free" comment, "features" and advertisements. How the materials are collected from various sources is clearly set out, as is also the varying forms of newspaper ownership. Mr. Thomas then deals with some important problems such as the maintenance of journalistic standards, the control of newspapers for profit, power, or service, the influence of advertising and the power of the Press to influence public opinion.

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* Oxford Pamphlets on Home Affairs. No. H(1): How Britain is Governed. By R. B. McCallum. Pp. 32. No. H(2): The Newspaper. By Ivor Thomas. Pp. 32. No. H(3): The Transition from War to Peace. By A. C. Pigou. Pp. 32. No. H(4): Britain's Future Population. By R. F. Harrod. Pp. 32. (London: Oxford University Press, 1943.) 6*d*. net each.

(3) Prof. Pigou's pamphlet deals with the more difficult subject of the post-war period. The following are some of the questions he poses : What is going to happen when war-time machinery is quickly reversed ? How will the transition back to peace-time production be effected ? Will those who were employed before the War get back to their old jobs ? Will those who have reached employable age during the War find jobs ? The author suggests answers to these and other problems mainly by drawing from the experiences gained during 1919–22. His essay will be of particular value to all those who are charged with conducting discussion groups in the Civil Defence Services and Armed Forces and will enable them to deal with some of the questions that are constantly being asked about the post-war period.

(4) "Britain's Future Population" discusses the tremendous problems that accompany a declining birth-rate. The method of presenting these problems leaves much to be desired, while the novel suggestions Mr. Harrod makes about the real causes of the fall of the birth-rate need fuller investigation.

In addition to the four pamphlets under review, preliminary announcements indicate that subjects to be dealt with in succeeding issues include the Civil Service, trade unions, the British political parties, education in Britain, law, money, agriculture, foreign trade, the problem of full employment and related topics.

RELIEF IN EUROPE AFTER THE WAR OF 1914-18

THE brief study on relief after the War of 1914–18, entitled "Relief Deliveries and Relief Loans, 1919–23", which has recently been issued by the Economic, Financial and Transit Department of the League of Nations, is one of a series devoted to a consideration of the lessons that may be learnt from past experience. It should prove of value in giving effect to the resolutions of the Food Conference at Hot Springs which, as Mr. Eden announced in the House of Commons on July 6, have now been accepted by the Government. Mr. Eden, in making this announcement, stated that the Government intends to press on with the task of increasing food resources and improving the diets of the people. It also intends to participate fully in the work of the Interim Commission to prepare a plan for a permanent organization in the field of food and agriculture. While the Conference was not concerned with the organization of relief supplies, attention was given to the need for increasing supplies of basic foodstuffs in the period when territories liberated from the enemy will be in need of help from outside, and Mr. Eden said that the Government is much impressed by the urgency and importance of this problem.

In reviewing the relief effort of 1919–23, it is pointed out that international relief on a scale comparable to what was required had never been previously undertaken. There was no past experience to serve as a guide, save that of the Commission for Relief in Belgium during the War of 1914–18. In regard to the volume and nature of relief, the report notes that although the child-feeding programme prevented a disastrous mortality, it was not adequate to prevent malnutrition. The real needs were never completely met, nor were they fully surveyed. Th were considered almost exclusively in terms of calori and the study concludes that the first action requir to meet such a situation with any hope of the be result is to estimate so far as possible in advan what the real needs of food (including protecti foods) and such essentials as soap, medicine and clot ing are likely to be and how far they can be met fro the available resources.

The War of 1914–18 ended in the autumn when th need was greatest, and the possibility of relying domestic supplies, except for cereals, was least. Th shipment and transhipment of goods to Europe w expeditiously carried out and great efforts were ma to effect actual deliveries with the least possib delay, but the continuation of local fighting and th breakdown of internal administrative organizati in many parts of Central and Eastern Europe, th absence of information regarding local needs, pa ticularly in these same areas, and the difficulti encountered in co-ordinating the relief efforts of th United States and the Allies, made impossible su stantial deliveries of foodstuffs, except in Belgiu and northern France, before the end of January 191 The major relief period was confined to February August 1919.

A further difficulty was the delay in obtaini legislative approval of relief credits ; this could ha been prevented if funds had been allocated duri the War. The stock situation in the United Stat was not such as to put difficulties in the way of larg scale export for relief purposes : the problem w rather to dispose of surplus. In the harvest ye 1918–19 the exportable surplus of foodstuffs was thr times as large as the pre-war annual exports. To-da the resources of available food consist not only of th stock of provisions at any moment of time, but al of the industrial equipment for preparing certa categories of protective foods in condensed form.

The study emphasizes once more that if th tonnage available is to be utilized to the best a vantage at a moment of extreme post-war urgenc a joint plan of allocation between the demands f the repatriation of troops, and transportation of foo stuffs, raw materials and other essentials requires be made in advance. As regards financial provisio in any policy of relief and reconstruction it is nece sary to decide first what sacrifice is to be made purely humanitarian grounds and what sacrifice it desirable to make to prevent social disturbances a to establish such order in war-affected areas as w permit the revival of economic activity. If adequa direct aid is not granted to render a country cred worthy, any subsequent scheme for reconstructi may break down and the credit granted under su a scheme prove unrecoverable. Relief and reco struction are two stages in an uninterrupted proce of transition, and the distinction between them determined not by the class of goods involved b by the conditions, or absence of conditions, for repa ment.

Once again the value of utilizing for relief adm istration the machinery which existed and o required expanding is emphasized, while the wit holding of relief credits from enemy countries is garded as a further illustration of the basic mista of failing to consider problems of reconstruction the outset. Finally, in considering what relief impl to any country granting it, it is necessary to consi not only the accountancy cost of the supplies th may be furnished, but also the real economic co

GRAPHICAL DETERMINATION OF ELECTRIC POWER CABLE RATINGS

A USEFUL practical study of this subject has recently been published by H. Waddicor (*J. Inst. Elec. Eng.*, 90, Pt. II, No. 15; June, 1943). The paper indicates the advantages of graphical methods for determining current-carrying capacities of power cables, and charts are described by which the ratings of three-core and single-core cables transmitting balanced three-phase loads can be obtained rapidly. The charts are applicable to cables laid direct in the ground or in air, and take into account the mutual heating effect of feeders laid in the same trench. Calculated and graphically determined values of rating are compared for a range of typical cases in order to exhibit the degree of accuracy obtainable.

In general, cable ratings are obtained by calculation from published rating tables, or by graphical methods. Individual calculations are precise but extremely tedious. Even with simplified methods of dealing with the various types of three-core cables, and the use of approximate formulæ for skin, proximity, sheath and armour losses, etc., the time involved is a serious item where many routine calculations have to be made. Their chief function is to enable accurate comparisons to be made between the carrying capacities of various types of cable laid under identical conditions. Tables of current ratings have been published by the British Electrical and Allied Industries Research Association, but have their limitations as they only give figures for cables for working voltages up to 22 kV., that is, for cables complying with B.S. 480–1933 and B.S. 608–1935. Graphical methods have the great advantages of flexibility and rapidity in use. In the design of the charts described in the paper, slight approximations are employed to maintain a balance between comprehensiveness and simplicity of operation, but the errors over the practical range are very small, and accuracy higher than is given by the tables is usually possible when dealing with non-standard conditions.

Variations between graphical and calculated values are caused by errors intrinsic to the chart design and those due to inaccurate plotting. The former are always small and the latter practically can be eliminated by large-scale charts; those used by the author measure approximately 48 cm. × 35 cm. In order to form some idea of the overall accuracy of the charts, a comprehensive range of cases has been taken and the ratings determined both by calculation and graphically. The results are given in the paper, which show that the maximum error involved is less than 2 per cent, the actual limits being $-1\cdot2$ per cent and $+1\cdot9$ per cent. Ratings can be derived from the charts in five minutes; calculation would require well over an hour.

The advantages claimed for the charts employed are that graphical methods of determining cable ratings are rapid and flexible; their overall accuracy is high, and they can be operated efficiently by personnel unacquainted with theoretical principles and methods; they are more comprehensive than the published rating tables, and for cables buried direct in the ground give more accurate results when applied to the diverse conditions of installation met with in actual practice; and graphical methods allow the effect of changes in ambient temperature, soil resistivity, depth of laying, or other factors affecting the cable rating, to be more clearly visualized.

RURAL ECONOMY IN YUNNAN

EVEN long years of war and retreat into the mountains have not stopped research of great social value carried out with a sympathy and fairness to non-Chinese folk that are altogether admirable. Yunnan's high rugged surfaces are cut by deep valleys; mountains tower above small upland plains; clans on the hills may long remain very separate from Chinese groups that have colonized the valley bottoms here and there; the hills may be sub-arctic at times, the valley bottoms may be almost tropical. Three authors have monographed Weits'un, where linger remnants of an almost feudal scheme, Luts'un, a village essentially of smallholders, and Yits'un, where poor cultivation is supplemented by crafts*.

In 1380 the Chinese occupied Weits'un and the native Lolos retired to the hills. In 1467 the Chinese resident, Hsu, took over all authority from the Lolo chief, and his house long retained overlordship, living in a town and collecting dues, but in the seventeenth century some came to live in the village and later enclosed and irrigated land in order to exact higher rent from it. Many of these Chinese landlords were killed in a revolt during 1847–72. The later settlement reinstated some Chinese but allowed the Lolos the right to buy land. Before the seventeenth century enclosures the forty-two tenants or allottees had been able to add to their lands, by digging up unused patches, without increasing their dues, which came to 1–3·3 per cent of the produce. In Hsu's time, fifty households with 270 people made up the village; in the seventeenth century there were ninety households with 530 people. Since the enclosures growth has been slow and there were, in 1939, 117 households with 637 people. Lolo land-hunger is a master passion, but there is little chance of gaining the wherewithal to buy. Chinese owners may lead idle lives for a while, but it is difficult for them to hold land worked for them by Lolos or to collect enough rent. Tenants may be begged to pay rent in advance, even to such an extent as to give these the right to seize the property; owners dare not refuse the request, and tenants often get into money-lenders' hands in the process. So they sink into poverty, and land tends to concentrate in a few hands, chiefly of moneylenders. The tenants try, with poor results, to keep afloat financially by seeking supplementary seasonal landwork in adjacent villages.

In Luts'un, 611 individuals live, for the most part, on the produce of 140 acres of rather good rice land. A family spends nearly half its income on rice and one eighth on other food. The village eats three thousand and produces nine thousand bushels. The largest holding is less than four acres, and only eighteen are of any size; thirty-eight out of 122 households are those of landless labourers. For a Chinese owner to save 'face' by living idle and employing Lolo labour he must have about two acres. Clans, clubs, temples, the village itself, the Water Regulation Association and the Government all own land, a good deal of which is let out at low rents, with some corrupt practice. An owner in debt tries to sell to his clan. Private purchasers have to obtain the consent of the seller's kin to the bargain. Sons divide the paternal inheritance. All in all it is just possible, here, to maintain a low standard of living.

* Three Types of Rural Economy in Yunnan. By Li-Yu-I, Hsiao-tung Fei and Tse-yi-Chang. Published in mimeograph. (Yenching-Yunnan Station for Sociological Research, January 1943.)

Yits'un supplements poor cultivation by basketwork on handicraft lines, with small but quick turnover, and by paper making, a process taking a year and making capital necessary. Paper mills rarely work all round the year for lack of bamboos, and they, like the land, are divided in inheritance. Investment in the poor land rarely pays, so profits from paper go elsewhere.

All in all, the lowly folk find advance almost blocked in every case and every direction unless one or two of them can become government officials and then use opportunities to enrich themselves and their families. One can but hope that efficient co-operative systems under schemes of public ownership may help these peasants. It is hoped that this interesting study may be made available in published form in England before long. H. J. Fleure.

ECOLOGICAL PRINCIPLES IN FORESTRY PRACTICE

At the invitation of the British Ecological Society, members of the forestry associations of Great Britain met on July 2 to discuss with the Society problems arising from a recent article by Sir Roy Robinson in *Forestry*. Prof. A. G. Tansley, opening the session, argued that the hypotheses of the "silvicultural stream" and of "accelerated succession" are based on ecological theories of succession, mixed plantings of pioneers and successors comparing with natural "telescoped" succession. He indicated the mutual benefits of still closer co-operation between foresters and ecologists, especially in investigations of the effects of pioneers on successors and of the autecology of exotic conifers. He also pleaded for due consideration by the Forestry Commission of the needs of nature conservation, particularly in view of the envisaged expansion of the Commission's programme after the War.

Sir Roy Robinson welcomed fullest co-operation from ecologists, the more especially because afforestation policy must be based on sound ecological principles. He indicated, among other pressing problems, those of soil relations, mixed plantations, and regeneration by means other than clear felling and planting. Prof. H. G. Champion instanced, from India, the ecological effects of soils and climates in determining the status of timber trees and the nature of climax and pre-climax complexes. He also discussed the importance of factors operating at comparatively long intervals, such as excessive drought and frost. Stressing the complexity of sylvicultural streams, he pointed out that afforestation may sometimes need to run counter to their currents. Dr. A. S. Watt stated the need for a dynamic conception of forest ecology. The pattern of the forest plantation must be determined by a variety of causes: microclimates, soils, relations between one plant and another, and the structure of the vegetation; the organic factors of the environment being no less important than the inorganic.

Discussion afterwards ranged widely over problems such as the status of afforestation programmes in national planning of land utilization and the construction of an ecological survey map of the British Isles; the function of shade bearers in controlling ground vegetation; the relative importance of surface vegetation and soil profile as a guide to planting; the functions of leaf litter, and of mycorrhiza and sub-shrub vegetation in regeneration; mixed planting and control of disease; the role of the smaller animals in the forest balance; and the need for preservation of samples of broad-leaved forest (*a*) for ecological study and advice in future programmes, and (*b*) as a part of the systematist's laboratory.

Sir Roy, replying to the discussion, reiterated his welcome of co-operation from ecologists, and stated that the Forestry Commission's ecological reserves would be re-established after the War, and that it is important to nominate now those woods desirable for such purposes, in view of the vast felling programme now in operation. L. A. Harvey.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

SPEECH THERAPIST (part-time)—The Education Secretary, Town Hall, Reigate, Surrey (August 20).

LECTURER (TEMPORARY) IN CHEMISTRY—The Registrar, University College, Southampton (August 25).

PROFESSOR OF PHYSIOLOGY, A SENIOR LECTURER IN ANATOMY, and A SENIOR LECTURER IN PHYSIOLOGY, in the University of Otago, Dunedin—The High Commissioner for New Zealand, 415 Strand, London, W.C.2 (August 31).

CHEMIST AND ASSAYER on the establishment of the South African Mint, Pretoria—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, London, W.C.2 (August 31).

HEADS OF THE DEPARTMENTS OF PHYSIOLOGY, MEDICINE, AND SURGERY—The Bursar, Royal Veterinary College and Hospital, at The University, Reading (October 1).

CHAIR OF NAVAL ARCHITECTURE—The Acting Secretary of University Court, The University, Glasgow (October 4).

ASSISTANT TO THE ADVISORY CHEMIST—The Secretary, South-Eastern Agricultural College, Wye, Ashford, Kent.

ASSISTANT (MALE OR FEMALE, preferably with a knowledge of Bacteriology and Chemistry) for Laboratory—The Pathologist, Cumberland Infirmary, Carlisle.

TEACHER (MAN OR WOMAN) OF MATHEMATICS, MECHANICS AND ELEMENTARY SCIENCE—The Principal, Erith Technical College, Belvedere, Kent.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Annual Report of Gresham's School Natural History Society, 1943. Pp. ii+32. (Newquay: Gresham's School.) [267

Curriculum and Examinations in Secondary Schools. Report of the Committee of the Secondary School Examinations Council appointed by the President of the Board of Education in 1941. Pp. ix+151. (London: H.M. Stationery Office.) 1*s*. 6*d*. net. [287

Medical Research Council. War Memorandum No. 10: The Medical Use of Sulphonamides. Pp. 46. (London: H.M. Stationery Office.) 9*d*. net. [287

Association of University Professors of Allied Countries in Great Britain: Educational Conference, May 11, 1943. The Function of a University in a Modern Community. Pp. vi+57. (Oxford: Basil Blackwell.) 1*s*. [297

Geological Survey of Great Britain: Scotland. Wartime Pamphlet No. 30: Sands and Gravels of Scotland, Quarter-inch Sheet 9: Elgin, Banff, Aberdeen. By Dr. J. G. C. Anderson. Pp. 27. (London: Geological Survey and Museum.) 1*s*. 4*d*. [38

Other Countries

Indian Forest Leaflet. Utilisation No. 37: How to Identify Timbers, Part 3: Timbers for Motor Lorry Bodies. By K. Ahmad Chowdhury. Pp. ii+17–30. 4 annas; 6*d*. Utilisation No. 41: Studies on Adhesives, Part 5: A Preliminary Note on Cold-setting Urea-Formaldehyde Resin Adhesives. By D. Narayanamurti and V. Ranganathan. Pp. ii+6. 4 annas; 6*d*. Utilisation (New Series), No. 116: Studies on Adhesives, Part 3: Casein Glues. By D. Narayanamurti, V. Ranganathan and Mohammed Ikram. Pp. ii+22. 4 annas; 6*d*. (Dehra Dun: Forest Research Institute.) [297

Indian Forest Records. Utilisation (New Series), Vol. 2, No. 10: A Survey of the Seasonal Variation of the Moisture Content of Indian Woods. By M. A. Rehman. Pp. vi+209–244+6 plates. 1.4 rupees; 2*s*. Utilisation (New Series), Vol. 3, No. 1: Note on Timber Roof Trusses with Solid Wood Disc Dowell Joints. By V. D. Limaye. Pp. ii+7+5 plates. 6 annas; 9*d*. Utilisation (New Series), Vol. 3, No. 2: The Thermal Conductivity and other Properties of some Indigenous Materials. By Dr. D. Narayanamurti. Pp. ii+13+3 plates. 6 annas; 9*d*. (Delhi: Manager of Publications.) [297

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FORESTRY EDUCATION

EDUCATION has often proved a thorny subject in Great Britain and is now again under very active consideration. But perhaps in no other branch has such a conflict of opinion existed and, it may be suggested, such a confusion of ideas combined with ignorance, as in the case of the training of the forester for the gazetted grades of the Government services. The subject first made its appearance in Great Britain after the institution of the India Forest Service in 1864. The late Sir Dietrich Brandis, first Inspector General of Forests in India, advised the Secretary of State of the necessity of providing trained probationers for the newly formed service. In the absence of any centre in Britain, the first selected men obtained their technical training at the forestry schools in Germany and France. This persisted until the inauguration of a forestry branch at the Royal India Engineering College of Coopers Hill in 1885. The late Sir William Schlich, who had succeeded Brandis as inspector general, was appointed professor, and the India forest probationers received their education at the College until it was closed down in 1905. On the subject of forestry, the Coopers Hill Committee, which in 1903 recommended the closing of the College as an educational establishment for training engineers for the public service in India, advised as follows:

> "As there is no efficient teaching of Forestry in the United Kingdom it will be necessary for some years to come that the Government of India should continue to provide for the education of the selected candidates. The Professor of Forestry and one of his Assistants must be maintained as heretofore. The question thus arises—where, in the absence of Coopers Hill, are Forest Officers to be trained? Although the average number of Forest Officers required by the Government of India will be only eight annually [a number which in actual fact was usually exceeded] the Government of India is too deeply interested in the matter to allow of its being left to chance, or to the future establishment of schools for instruction in Forestry in accordance with the recommendations of the Departmental Committee which reported to the Board of Agriculture. We think that it is possible, without much difficulty, to arrange for the transfer of the Professor of Forestry and even of his Assistant, from Coopers Hill to Cambridge or Oxford or Edinburgh. At the last-named University there is already the foundation of a Forest School [a lectureship in forestry was established in 1887]. . . . On the understanding that the pay of the Professor and his Assistant is provided by the Government of India, that Government should have a controlling voice in the choice of a Professor and in prescribing the course of instruction to be followed. Hereafter, when Schools of Forestry with suitable staffs and sufficient equipment shall have been established with success, their degrees or diplomas may be accepted as proof of sufficient technical training, and the selection may be made from those who have acquired those degrees and diplomas, and are otherwise well qualified. When this condition has been reached, the Government of India need no longer concern themselves with the teaching staff or the course of instruction."*

The above represents the reasoned opinion of the representatives of one of the Departments of State (the only one) who had before them at the time forty years experience of the working of the Indian Forest Department and its officers. Schlich decided upon Oxford, and the Secretary of State for India made a grant to the University.

The position of affairs was soon regarded as unsatisfactory both by the Government of India and the Secretary of State. A committee was appointed in 1908 to inquire into the selection and training of probationers for the Forest Service, consisting of Mr. R. C. Munro Fergusson (later Lord Novar), Sir John Edge, Sir W. Thiselton-Dyer, Mr. (later Sir) E. Stafford Howard, commissioner of woods and forests, and Mr. (later Sir) S. Eardley Wilmot, inspector general of forests, Government of India. In its recommendations the Committee said:

> "The advantages of a healthy competition between various Forestry Schools outweigh in our minds the benefits of a centralised training. Recognising, therefore, the importance of encouraging Indian Forestry education at other centres, and considering that giving a monopoly to any one centre must tend to discourage other centres from developing an adequate course, we recommend that a Professor of Forestry with an Indian experience be provided for centres such for example as Cambridge and Edinburgh as soon as the authorities of such centres have satisfied the Secretary of State in Council that a proper equipment for teaching forestry is provided at those Universities, and that their forestry courses will be open, as the Oxford course is at present, to any selected probationers."

The recommendation to provide a professor proved unnecessary. The Universities of Cambridge and Edinburgh, with the expressed opinions of these two Committees before them, set to work to fulfil the request. Cambridge had appointed a lecturer in forestry in 1907. Edinburgh inaugurated a degree of B.Sc. in forestry in 1909, and both built up forestry departments. In 1910 both Universities were recognized as qualified to train probationers for the India Forest Service. By this time the Colonial Office had also come into this market. Since that date, both the University of Aberdeen and the University College of North Wales, Bangor, have established forestry departments.

The old idea that one centre of training in Britain would suffice to supply all the recruits likely to be required for the India and Colonial Forest Services had not died, and periodically raised its head. But the universities were not greatly perturbed. They realized that competition, especially in educational matters, was the life-blood of the business; that a localized and centralized education of whatever type became inevitably parochial in its outlook and teaching. If this is true for more general forms of education, it is certainly so in the case of forestry.

This matter has come to the fore again in two separate forms. In *Australian Forestry* (6, No. 2; 1942), under the title "Higher Forestry Education", details are given of a controversy which has arisen between the State of Victoria and the University of Melbourne and the Institute of Foresters (whic publishes *Australian Forestry*). The Institute suppor the Australian Forestry School of the Commonwealt Government situated at Canberra and established 1926 with the sanction and support of all the State The State of Victoria no longer finds that th centralized school fulfils its requirements, and pr poses to set up its school in the University.

All the arguments used in this article (which is Report to Council by the past-president of t Institute) are old ones which have been voiced Great Britain and in India during half a century an more, and more latterly perhaps in connexion wi the British Colonies. The Institute's attitude summed up as follows:

> "The Institute deplores the violation of t principle of one national school for higher forest education in Australia. It makes an urgent appe to all persons interested in the progress of forestr in this country to support its action in condemnin this ill-conceived proposal."

The council of the University of Melbourne w not, however, to be deflected from its purpose. T Registrar pointed out that the action of the Universit was the natural result of twelve years experience the arrangements entered into in 1929, and he ga the reasons. The Premier of Victoria, in replying t the president of the Institute of Foresters, pointed o that:

> "The training of Staff for State Forest Service a matter regarding which Victorian Governmen have had thirty-two years experience. It has teste all the facilities for such training which have offere and considers that its own Victorian school, esta lished in 1910, and actually pre-dating both t Adelaide and Canberra establishments, most ad quately meets its requirements from the standpoi of Staff training. That it has now been decided th graduates from this school, who take their cour in association with Melbourne University, shall granted a degree in Forestry, seems both a logic and reasonable development, and one, moreove which should in no way disturb the existing positi as regards forestry education in Australia."

In Great Britain, on several occasions since t War of 1914–18, forestry education at the universiti has been under fire from Government department and from the Forestry Commission.

It has proved difficult, however, to obtain consensus of opinion as to what is considered to actually wrong. There appears to be some idea th the young university graduate should receive a f training as a woodman; or that the practical cours are not lengthy enough or sufficiently detailed; again, that the course should be a four-year o instead of three. There is usually a widespread failu to appreciate the fact that, at a university, forest is only one part of the varied curriculum which t undergraduate has to undertake, and that the vario courses are dovetailed with those of a number other departments. Why the so-called higher forest education should be considered as something exce tional and apart from other forms of training difficult to understand; for other courses of education at a university, if successfully undertaken, offer far higher emoluments in a subsequent career than a forestry service ever does.

Then again, an idea appears to persist that a forestry training should be carried out on the lines of an agricultural one. There is no similarity in the work. Government agricultural officers either engage in research or in purely advisory work, or are in charge of experimental stations with grants-in-aid to show improved methods of farming. The forest officer, on the other hand, has often charge of large areas of forest which, apart from their indirect benefits to the country, he is expected to make pay for themselves.

As a result of the War, there appears to be a probability that the Forestry Commission in Great Britain will increase its activities considerably. In such an event, it has already become obvious that the Commission will require to recruit a number of trained young men annually to its gazetted grades. This will, not improbably, apply to other Government forest services in the British Empire. Where are these trained men to come from?

Administrative circles concerned with forestry are in danger of repeating the mistakes of the War of 1914–18. During that period, recruiting for the forest services of the British Empire ceased. After the armistice of 1918, there was a great demand for young trained forest officers to fill the depleted ranks of the gazetted services. Large numbers of probationers were selected and sent to the universities to be trained. The latter, to grapple with the unprecedented situation, instituted shortened courses, doubling up some courses, giving shortened ones in others, and omitting a few. The results, as seen in forestry events of the past twenty years, have been by no means satisfactory, and in some cases even disastrous. In spite of this lesson and of warnings intimated during the present War, a not dissimilar position has once again to be faced—with the addition of the home forest service and its projected great increase in activities and demands for trained officers. Past experience shows the inadequacy of seriously shortened university courses. Given that the actual room exists to train a considerably increased number of candidates, the university forestry departments could train the necessary number of recruits within a reasonable period of time—but it must be pointed out emphatically that a training in forestry includes, apart from the science subjects proper, courses in applied science involving laboratory work such as, for example, forest botany, mycology, chemistry, entomology, and that room for larger classes attending these courses must also be available.

In other words, the various Governments of the British Empire, instead of criticizing and demanding much shortened courses in order to be able to start off at once on newly conceived and enlarged work, should realize that the universities of Great Britain, as a result of thirty years experience, are fully cognizant with the requirements of the training of the forest officer; that they know where their part of this work ends, and that of the officers of the Government departments concerned commences. For the newly joined young assistant conservator of forests has of necessity to be initiated in the particular methods of administration in favour in the country in which he is to serve, and often to study the habits and laws, and perhaps language, of the people among whom he is to serve. It will be obvious to all acquainted with university education and administration that such subjects and matters do not fall within a university curriculum which aims at giving the forestry aspirant a sound first degree in forestry.

AMERICAN EXCAVATIONS AT THEBES

Excavations at Deir el Baḥri, 1911–1931

By H. E. Winlock. Pp. x+235+96 plates. (New York: The Macmillan Company, 1942.) 30*s*. net.

THE site of Dêr el-Baḥri, on the opposite side of the Nile to Luxor, is familiar to all tourists in Egypt, for on it stands the most beautiful temple surviving from ancient Egypt, built in the Eighteenth Dynasty by Queen Ḥatshepsut. This temple and the adjoining Eleventh Dynasty one of King Nebhepetrē‘ Mentuḥotpe were excavated on behalf of the Egypt Exploration Fund between 1893 and 1907, and the results of this work were published in a series of memoirs familiar to all Egyptologists.

The possibilities of the site, however, were not yet exhausted, and in 1911 an expedition of the Metropolitan Museum of Art, New York, under the direction of Mr. H. E. Winlock, was granted the concession. For a generation—apart from the interruption due to the War of 1914–18—the New York party remained in possession, and work continued season by season, not only on the temples already largely excavated, but also on the adjacent tombs of notables, not to mention the early Christian monastery of Epiphanius close at hand and the palace of Amenophis III a short distance to the south. Every year when the digging season was ended and the expedition had returned home for the summer, a brief account of the season's work and discoveries was published as a special number of the Museum's *Bulletin*, and these annual reports, with a very considerable selection of their photographic illustrations, have now been garnered into the volume under notice, thus providing a consecutive narrative of twenty years digging which makes very interesting and at times entertaining reading, while the ninety-six plates collected at the end are admirable, and indeed contribute very materially to the value of this book to the student.

It is impossible in a short review to do more than indicate the most important results achieved by the excavators. In the Eleventh Dynasty temple of King Mentuḥotpe the original ground-plan of the temple courtyard was discovered, a plan that was considerably modified before the temple was completed. They also cleared the processional causeway leading up to the temple, as well as the adjacent causeway of Tuthmōsis III of the Eighteenth Dynasty, which led to the chapel of Ḥatḥōr cut into the cliff cheek-by-jowl with the earlier temple. But most interesting and important of all was the discovery within the temple itself of the burial-places of a Queen ‘Ashayet and of a little girl Mayet (‘the Cat’) which the previous excavators had missed. The burial of ‘Ashayet had been robbed and her mummy ripped open in the search for treasure, but her wooden coffin and stone sarcophagus—the latter sculptured without and painted within—were intact. The other burial was intact, but the uninscribed sarcophagus contained only the body of a little girl of five buried in second-hand coffins. The tombs of Mentuḥotpe's officials in the cliffs adjoining yielded the marvellous wooden models portraying life on the estate of the Chancellor Meketrē‘, the untouched burial of his steward Waḥ, and part of the correspondence of a land-owner named Ḥekanakhte, from one of whose letters we gather that famine was so sore in the land that in at least one village the people were reduced to cannibalism. In yet another tomb were found an embalmer's table and jars, while a quite unexpected discovery was a common burial of about sixty soldiers who had been killed in action, apparently during the civil war which resulted in the establishment of the rule of the Theban Mentuḥotpes over all Egypt.

As regards the temple of Queen Ḥatshepsut, the principal result was the recovery of innumerable fragments of the queen's statues and sphinxes which had been thrown out of the temple and destroyed by the order of Tuthmosis III, and the reconstruction of a number of them from these fragments. Another important discovery was a second tomb of Senmut, unfinished, but with a remarkable astronomical ceiling. Incidentally, on pp. 143 ff. the author gives a much more reasonable account of 'the Feud of the Thutmosids' than that invented by Sethe and accepted by Breasted. Another interesting discovery was the burial of Meryetamūn, daughter of Tuthmosis III and consort of Amenophis II, whose tomb has since received full publication, while yet another find was a tomb containing the bodies of three princesses of the Twenty-first Theban Dynasty.

There is much more of interest in this book than there is space to mention here, and it will make a welcome addition to the student's library. But with all its interest, it remains but a preliminary report. No excavation is justified which does not end in detailed publication of the finds, and it is earnestly to be hoped, for the sake of the advancement of knowledge, that the Museum authorities will endeavour to ensure publication of their wonderful material as speedily as circumstances permit, and so make it accessible to Egyptologists everywhere. Everyone will have his own choice, but the present reviewer would like to see precedence given to the tomb of ‘Ashayet, the burial of Waḥ, and the Ḥekanakhte correspondence, each of which in its own way is of outstanding importance.

As regards the book itself, there is much to praise and little to criticize. It is of convenient size, clearly printed, and, as already remarked, the plates are admirable. It is also going to save the researcher much time and trouble to have all these annual reports conveniently under his hand instead of their being scattered through the files of a possibly inaccessible periodical. A couple of tiny slips have crept in: on p. 79, l. 21, for pl. 45 read pl. 44; on p. 138, l. 3 from bottom, for pl. 65 read pl. 63. The kings' names Amen-ḥotpe, Thut-mose, are rendered thus instead of in the classical forms Amenophis, Tuthmosis, preferred by English scholars; this is only a matter of taste, but I fail to understand why S‘en-Wosret always has the diacritical mark following the Ṣ; there is no ‘*ayin* in this name.

R. O. FAULKNER.

BASES OF PHYSICAL CHEMISTRY

A Treatise on Physical Chemistry

A Co-operative Effort by a Group of Physical Chemists. Third Edition. In Five Vols. Vol. 1: Atomistics and Thermodynamics. Edited by Prof. Hugh S. Taylor and Prof. Samuel Glasstone. Pp. vii+679. (London: Macmillan and Co., Ltd., 1942.) 42*s*. net.

THE volume under review is the first volume of the new and expanded (third) edition of "A Treatise on Physical Chemistry", first published in 1924. The new edition is intended to provide an up-to-date and comprehensive review of the whole of physical chemistry in five volumes covering, respectively, atomistics and thermodynamics, the states of matter, chemical equilibrium, chemical kinetics, and, finally, molecular structure. It will be seen from this programme that the subject-matter is very comprehensive. The editors may clearly so interpret such a programme that it may embrace, without causing surprise, the whole of molecular physics and chemistry in all their ramifications, including, for example, some branches of these subjects which are not commonly thought of as physical chemistry or chemical physics.

The border-line between molecular physics and chemistry has become so indefinite that it would be wrong for any reader to criticize the editors and authors for their choice of included subjects, provided these come under the general heading of the properties of matter, with perhaps the proviso that the molecular structure of the matter in question is relevant. These considerations of scope are of immediate importance to the reader, for they will occur to him on reading the first chapter of the first volume, when he is plunged into consideration of nuclear structure, from the study of which, as a physical chemist, he may have felt himself mercifully relieved. A little further reflection, however, will convince him that the whole subject of stable and unstable isotopes, particularly of the common elements, and their separation and use, is essentially a branch of physical chemistry. Some methods of isotope separation, in fact, might be regarded as perfect examples of physical chemistry as distinct from physics or chemistry. Realizing this, and that a knowledge of nuclear structural varieties is naturally of interest to the user of isotopes, he will pull himself together and eagerly accept this expansion of his subject.

The volume under review is rather by way of an introductory volume to the whole treatise. It may be described as "Prolegomena to the Study of the Properties of Matter, for which its Molecular Structure is Relevant". The proviso is still of some importance. There are some properties of matter, studied, for example, in elasticity and fluid dynamics, in which the molecular structure can still sometimes be tacitly ignored. But even here signs are not lacking that this ignoration will not for long persist, and the deeper study of the properties of matter will soon proceed in all branches with explicit reference to its molecular structure and the properties of atoms and molecules. According to this interpretation of the programme of the treatise under review, any study of the properties of matter will then be a branch of physical chemistry, and none the worse for that! Future editors of this "Treatise of Physical Chemistry" may then arrange that it embraces an even wider scope. They will (or may) include sections, or rather volumes, on aerofoil theory and plastic flow in metals as part of one unified whole, "The Properties of Matter". This, however, is looking forward into the future. It may be possible and convenient when that time comes so to redefine physical chemistry as to retain for it a somewhat more limited scope, not greatly different from the present.

We must now return to this actual volume on atomistics and thermodynamics, and describe what it actually contains, with comments on the manner of treatment of the various themes. But it should be clear after these preliminary remarks that what the reviewer or reader must not do is to say of any section: "This is not physical chemistry, and should not be included".

This introductory volume consists of four chapters which are each of the nature of a more or less exhaustive monograph on their respective fields.

Chapter 1, entitled the "Atomic Concept of Matter", is by Prof. H. S. Taylor himself. No doubt with the view of emphasizing the importance of isotopes to the physical chemist, it is strongly nuclear in flavour, and might also be regarded as a short introductory survey of nuclear physics leading up to the necessary tables of isotopic varieties, stable and unstable (Tables XV and XVI). Short descriptive accounts are given of the various forms of precision mass-spectrographs in effective use, and also of the methods employed for the separation of isotopes in bulk. The account given of Clusius' important method of separation by a combination of thermal diffusion and convection will be found particularly valuable.

This monograph is then to be regarded as a general introduction to the atomic concept of matter, with special reference to the existence and separation of isotopes. Many matters are naturally touched on rather lightly in passing, of which, not being specially concerned with isotopes, the account given cannot do more than whet the appetite of the reader who is otherwise uninstructed. This, of course, is unavoidable in such a book. Chapter 1 cannot reasonably be expected to stand as an authoritative text on nuclear physics.

Some minor criticisms of detail may be made. It seems a pity that the periodic table of the elements is not given in the up-to-date form which logically follows from Bohr's theory, with the inert gases closing the various periods. The older form given on p. 8 is perfectly in order where it appears in this chemical introduction, but it should be supplemented later in the chapter by a modern version. Again, this chapter gives rise to a feeling that too much valuable space has been devoted to discussion of the precision values of the fundamental physical constants. Any such discussion to be of real value must be much more elaborate. This being rightly not attempted, a categorical statement should be made of the values to be adopted in this treatise. There is no useful half-way house. Finally, an incautious statement on the absorption of β-rays on p. 35, implying also that they possess no "range" in a stopping material, needs attention. Reference, for example, to Rutherford, Chadwick and Ellis, "Radiations from Radioactive Substances", shows that the effect is an extremely complicated mixture of scattering and energy loss, and any categorical statement such as that referred to is extremely misleading.

Chapter 2 consists of a substantial monograph on the quantum theory of atomic spectra and atomic structure by Dr. Saul Dushman. That the quantum theory is part of the necessary prolegomena to a deep study of physical chemistry cannot for a moment be questioned, but it must be asked what is the special feature of Dushman's treatment which makes it specially suitable as a text for study by physical chemists. Should they be advised to learn their quantum theory from this monograph or to use it preferentially as a handbook of reference? Various other texts on the quantum theory spring to mind as possible competitors—among others, Ruark and Urey's "Atoms, Molecules and Quanta", White's "Introduction to Atomic Spectra", Condon and Shortley's "Theory of Atomic Spectra", Frenkel's "Wave Mechanics" and Kemble's "Fundamental Principles of Quantum Mechanics", besides Dirac's "Quantum Mechanics" or Sommerfeld's "Atombau und Spektrallinien". But on reflection it must be admitted that for one reason or another none of these is quite fitted for the precise needs of the physical chemist. A specially adapted text is called for, and this Dushman sets out to provide on a plan which lays special emphasis on the experimental information on which the accepted views of the structure of the atom are based, and avoids so far as possible all appeal to any but the simplest mathematical aspects of the theory. As a result of his plan, the treatment may be thought to refer rather more to certain early stages in the development of the theory which are now largely of historical interest, such as Sommerfeld's treatment of the relativity doublet. It is, however, a matter of great difficulty in such an exposition to strike the correct balance between a too historical and a too abstract and *a priori* presentation. It may be agreed that Dushman has followed the middle way very successfully and in a manner well adapted to his purpose, though naturally individual tastes will differ from him here and there on matters of detail. The chapter forms an eminently suitable introduction or refresher course for a physical chemist, especially if supplemented by some more abstract treatment later on.

Chapters 3 and 4 are not so easily separable, and really constitute a single monograph on thermodynamics, with special attention to the use of thermodynamic functions constructed by the methods of statistical mechanics. Chapter 3, on the First and Second Laws, is again by Prof. H. S. Taylor himself. Chapter 4, on the Third Law of Thermodynamics and the use of the methods of statistical mechanics, is by Prof. J. G. Aston. Thermodynamics and statistical mechanics are together the keystone of any treatise on physical chemistry, and the value of this treatise must depend on the virtues of these chapters in a much more direct way than on the other two monographs, important as these are. The exposition of thermodynamics and statistical mechanics that they contain can be considered from two points of view: first, that of the instructed user who has already learnt the fundamentals of the subject and wants a convenient text with the right flavour to which he may refer for theorems and results when required in the course of his studies; secondly, that of the learner of the subject who needs to absorb the fundamentals from a systematic and logical treatment of the most up-to-date type. For the first class of user the exposition here given is wholly admirable. It does not matter to such a user how the fundamental functions are defined or how the fundamental connexion between thermodynamics and statistical mechanics is established. It will fill his requirements if important theorems are clearly set out without omissions, and the results of the statistical construction of thermodynamic functions given properly. From this point of view the treatment is admirable.

For the second class of user the treatment is, in the opinion of the reviewer, not so satisfactory, but his complaints are directed rather against the general fashion in thermodynamic exposition than against the book under review. He cannot help wishing that more attention had been devoted to giving a more logical exposition of the fundamentals on the basis of mechanical concepts without the introduction of undefined thermal concepts, somewhat after the manner shown to be possible by Born in his series of expository articles in the *Physikalische Zeitschrift* (1921), based on the ideas of Carathéodory, which Born greatly simplified. The reviewer fears he is fighting a losing battle over this. Few other students of thermodynamics appear to share his tastes and prejudices in this matter, but he is unrepentant. The logical beauty possible by the Born-Carathéodory approach is very great and extremely satisfying. The clarity gained by beginning the development of the theory of heat at the beginning with the *Zeroth* Law of Thermodynamics, the *existence of temperature* (on an empirical scale) with only the concepts of mechanics assumed *a priori*, is outstanding. But these admittedly are matters of taste.

Another matter of taste, on which the taste of the reviewer differs violently from the authors, is the introduction of absolute entropy. Now that the old abuses and errors associated with this idea have all been swept away, no great harm is done, if it is agreed that entropy can and shall be so defined that the entropy of every perfect crystal is zero at the absolute zero of temperature. There is no need to do so, but it is generally agreed that there is a gain in elegance in so doing. But the absolute entropy in common use is only absolute in a rather sophisticated way. What is of practical utility is almost always entropy statistically defined but with *nuclear spin weight omitted*, which has the limit zero in theory and practice when one extrapolates to zero ideal calorimetric measurements from any hitherto accessible temperature range. An absolute entropy which tends to zero at zero temperature for any material assembly is definable but probably not often practically realizable, and should be introduced with much circumspection. Nor need it be made the keystone of the Third Law of Thermodynamics, nor Nernst's Heat Theorem deduced therefrom. Such is the private taste of the reviewer—probably nowadays an unnecessary prejudice derived from scars on his mind caused by much study of the appalling nonsense written about absolute entropy in the days before Ehrenfest and Trkal showed how futile it is to discuss the dependence of entropy on the number of systems in an assembly without including means by which that number can be varied reversibly. Associated with the presentation of absolute entropy is the type of connexion adopted between the thermodynamic functions and their statistical counterparts. The connexion adopted here is to make the direct connexion in Boltzmann's manner between entropy and a suitably defined 'probability'. Again the reviewer must admit that he dislikes this method, and considers that the connexion should logically be made through the Second Law and showing that the statistical method provides two functions of the state of the matter in question with the right properties to play the parts of T and S in the equation $dQ = TdS$. This is again a matter of taste.

To sum up, mainly from the point of view of the instructed user, this is an extremely valuable book. The physical chemist who knows his way about it will be well equipped with the fundamentals of his trade. There is a good and comprehensive index, but in view of the scope and variety of subjects treated, one may perhaps regret that an elaborate table of contents was not provided as well. Perhaps this may be done in the next reprint. The book should be widely used.

R. H. Fowler.

WORLD FLORAS

Geographical Guide to the Floras of the World

An Annotated Selected List of Floras and Floristic Works relating to Vascular Plants, including Bibliographies and Publications dealing with Useful Plants and Vernacular Names. Part 1: Africa, Australasia, Insular Floras, North America and South America. By S. F. Blake and Alice C. Atwood. Pp. 336. (Washington: United States Dept. of Agriculture Miscellaneous Publication No. 401, 1942.) 75 cents.

A COMPREHENSIVE world list of regional floras has long been a desideratum. It is now halfway to being realized by the publication of this volume, the first of two parts which aim at providing "an annotated summary of the available, nominally complete publications on the vascular flora and the economic botany of the world", complete up to 1939. No list of the scope of this one has previously been published. While it enumerates more than 3,000 titles, its aim is usefulness and not bibliographical completeness. Papers dealing with only a section of the flora of any region, monographs and revisions of genera or families, or those works which are primarily ecological are excluded, as are all works of a 'popular' type intended for beginners.

The publications listed under each geographical area are arranged under two headings: first, general works covering the whole region, followed by local floras dealing with smaller areas within the greater. Each publication is listed in full only once, but cross-references are provided. Annotations appended to each work indicate the scope of its contents, such as the presence or absence of information as to topography, geology and climate and exact geographical area covered where this is loosely conveyed in the title, data as to previous botanical exploration, ecological information, the inclusion of vernacular names and presence or absence of a bibliography. The total number of species described or listed in each work quoted is usually given.

The catalogue affords data for a summary of the knowledge of the floras of more than half the world, and such a summary is given indicating those regions with and without floras and those insufficiently known or inadequately covered by published works. Australasia and Greenland are the best served with systematic works; and South America, with half its countries lacking even a comprehensive list of species, is the least well known. It is more surprising to learn that in the United States "a severe critique might reduce to not more than about 13 the number of States with moderately satisfactory floras".

This is an invaluable reference work and the part dealing with Europe and Asia will be eagerly awaited. The detailed geographical index facilitates ease of reference, and there is also an index of authors.

W. A. Sledge.

COLONIAL LABOUR AND SOCIAL DEVELOPMENT

MAJOR ORDE BROWNE, labour adviser to the Colonial Secretary since 1938, has presented nother of his valuable surveys, which have already covered Northern Rhodesia, the West Indies and West Africa. The latest report, which deals with ecent labour conditions and recommendations for development in Ceylon, Mauritius and Malaya*, is marked by the same emphasis on the point that labour problems can be adequately analysed and met nly in the context of general social development; nd on the consequent need for simultaneous advance n many fronts. There is also recognition that it is often desirable to make haste slowly by means of a careful search for the most practical and comprehensive policy.

The comparative prosperity and the considerable dvances in representative government have given labour problems in Ceylon very considerable political prominence, and this has been enhanced by the arge-scale immigration of Tamil labourers from India. The Government of India has effectively intervened to safeguard conditions of labour for its own nationals. Ceylon also presents in fairly typical form the problems of the three distinct forms of Colonial labour—on plantations, mines and in the towns—and many of the issues that are taken up, such as the security of migrant plantation workers, the high living costs in relation to wages of urban labourers, and the problems of health and housing, have a onsiderably wider application in the British Colonial Empire.

On the plantations, now mainly devoted to tea, he owner-planter has steadily given place to the ompany, the directors of which instruct the manager from afar with limited knowledge of changing local conditions, while the immigrant Tamil labourers, eturning less frequently to India, are becoming stabilized as a permanently transplanted population. Old standards and practices such as housing in 'lines' uitable only for temporary occupation, and direction of labour through headmen who recruited and controlled indentured labour, have become seriously outmoded and tend to bar further progress. At the same ime, agreements with the Government of India have mposed on the estates obligations with regard to medical care and schooling that are normally regarded as falling upon Government.

Major Orde Browne asks for a new departure, slow though it may be of full achievement, based on the recognition of the new situation, so that plantation labourers and their families can live in their own communities and be provided with adequate social services, as well as housing, which would no longer be dependent on their continued employment on a particular estate, and he advocates in certain areas the creation of village settlements under Government auspices to achieve this end. Meanwhile, he suggests other means to deal with what is one of the knottiest problems associated with the plantation system, namely, that of providing adequate security of tenure for the labourer without invading the rights of the management, obviously essential in the last resort, to dismiss unsatisfactory workers. Dismissal of a plantation labourer often leaves him a landless stranger in an alien community with no home or means of support for the household which he has brought with him. In the past there has often been no alternative between dismissal and allowing unsatisfactory conduct to go unpenalized. To meet this Major Orde Browne suggests an approved scale of fines subject to the consent of the labour officer and with a right of appeal.

The Indian labour on the plantations and in the towns is now estimated to approach seven hundred thousand in all. In conjunction with growing pressure on the land occupied by the indigenous Ceylonese, this situation has produced a growing communal friction based on jealousy of the Indian workers who, in their greater dependence and amenability, have advantages from the point of view of the estate or office manager and are at the same time protected by regulations secured by the Government of India. There is little doubt that Tamil labour enjoys a privileged wage position as compared both with his fellow in India and with Ceylonese in Ceylon. This discrepancy may be fanned into a very serious political cleavage, and obviously requires, even where friction is based on misconception, prompt and persistent action in a territory where the movement towards self-government is so far advanced. Among other proposals to eliminate this serious source of friction between Ceylonese and Indians, it is recommended that the existing legislation safeguarding the conditions of employment of Indians shall be extended to apply universally.

Urban conditions in Ceylon, as so often elsewhere, are found to be less satisfactory than would be commonly supposed, since paradoxically enough social ills may be less readily perceived in towns than in even remote rural areas. The root of the difficulty is the divorce of the urban labour from that considerable degree of self-subsistence in food, housing and other domestic needs which the rural population can combine with wage-labour. Above all, house (or rather in most cases room) rents which, particularly in Colombo, for a variety of reasons including shortages and insufficient use of local materials have been very high, absorb a most disproportionate amount of wages, the real value of which are in consequence far less than those of the rural labourer. A recent inquiry revealed that the incomes of the lowest paid workers in Ceylon, even when in continuous employment, were insufficient to maintain a barely adequate standard of nutrition and shelter. In this connexion the Mauritius report refers to a salutary example, in the Bell Village estate, of an impulsive and ill-conceived housing development which rapidly became derelict owing to insufficient investigations into siting, constructional and other requirements.

A similar need to avoid too rapid an establishment of Western forms, as distinct from pressing on towards Western standards, is apparent in the field of labour organizations. Trade unionism in Ceylon is embryonic and finds little sustained support among workers, in either a consciousness of solidarity or a capacity for organization. The would-be trade union organizer has too often been an outsider, sometimes disaffected, who sees a career and way to achieve some degree of personal power through the urging of his notions of the methods and objectives of unionization on inexperienced groups of workers. The social implications are clear. Union organization as a means of raising living standards and working efficiency through collective bargaining can only be satisfactorily developed *pari passu* with the advance in education and in a genuine sense of community of enlightened interests among the workers themselves. While the dangers that the vulnerability of unorganized workers may be abused are real, the activities of ephemeral and sometimes bogus labour organizations which do not command the loyalty of workers or serve their genuine interests may be ultimately as harmful to their welfare and working conditions. A significant instance of often serious indifference among the people themselves to improvements in working conditions and hours, when immediate money returns are held to be paramount, was found among Chinese brick workers in Malaya, who refused to agree to the curtailment of an 84-hour week.

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* Labour Conditions in Ceylon, Mauritius and Malaya. Report of Major G. St. J. Orde Browne. (Cmd. 6423.) Pp. 114. (London: H.M. Stationery Office, 1943.) 21*s*. net.

The difficulties in applying Western standards of social security in Colonial territories like Ceylon and Malaya, where even under conditions of comparative prosperity national income and Government financial resources are so limited, becomes very plain. It would have been interesting in this context to have learnt how far work on plantations and in the towns has undermined the solidarity of family group life. These groups frequently provide their own mutual insurance and spreading of risks under peasant conditions. But they have proved very vulnerable in many territories to the introduction of personal incomes from wage labour. Their protection against rapid disintegration while alternative forms of group organization or social services are developed in their place poses a serious problem in applied sociology.

The vicious circle of poverty, under-nourishment, poor health and low output of labour, which does not in consequence earn an adequate purchasing power, is more than generally obvious in Mauritius. The attempt to break this circle should, as Major Orde Browne emphasizes, underlie all development plans and in particular it should include full attention to the need for improving the feeding and thereby the health of the rising generation through the provision of school meals and other means of raising nutritional standards.

As has been indicated, these reports emphasize the need for a comprehensive view of the context of Colonial labour problems. Of the many lessons to be learned there is perhaps special need for emphasis on one which does not find direct expression in the reports themselves. Major Orde Browne alludes at every turn to the lack of adequate data for the analysis of the actual situations and confident formulation of policy. He makes some recommendations for additional appointments and duties in the Labour Departments; but the complexity of the problems and the many gaps in existing information all point to the need for the earliest possible programme for social surveys in the Colonial Empire by trained investigators. Reports such as these leave little doubt as to the general nature of the problems, but for the proper selection and integration of development projects a more adequate and comprehensive body of empirical data is needed. We have so far in the British Empire paid too little attention to the development of applied sociology, to the training of field workers and the organization of comprehensive investigations. Much could be learned from substantial American experience and achievements in this field. The latter have been remarkable for their investigations and the planning of remedial projects in backward or depressed areas. Colonial development offers one among several opportunities for the fruitful application of the social sciences, and valuable work of this kind is beginning in the West Indies. The provision and harnessing of a sufficient body of workers, trained in social anthropology, survey methods and rural economics needed for this task are long overdue. Such training and organization will take time, and the earliest start should be made in preparing for them immediately after the War.

DARYLL FORDE.

MODERN DRUGS AND TROPICAL DISEASES

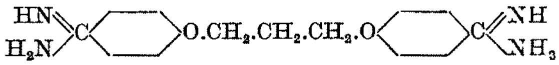
WHEN primitive man first began to use tools, he presumably employed stones or branches which he found fortuitously in shapes suitable for his purpose. Later he learnt how to fashion implements by simple modifications of pre-existing material, and in recent years he has built the vast and complicated machines which now sustain our modern civilization. A similar, but less extensive, progress can be seen in the realm of therapeutics. For long ages medical men were restricted to simple herbal and mineral remedies; then steps were taken to isolate the active alkaloids and other principles and to make simple chemical modifications in them; lastly, since the days of Ehrlich and his predecessors, therapy has come to rely more and more on compounds synthesized especially for this purpose by the organic chemist, on lines previously unknown in the vegetable, animal, or mineral worlds. This modern state of drug therapy is well illustrated by a discussion which was held at the Royal Society of Tropical Medicine and Hygiene on July 14 on "Modern Drugs in the Prevention and Treatment of Tropical Diseases". The only drug of natural origin which was mentioned was quinine, the purified alkaloid from cinchona bark. All the other substances discussed were compounds which have been prepared for the first time not more than ten or twenty years ago.

The chief speaker was Colonel S. P. James. He began by referring to the great contributions made to our knowledge of the subject by the late Prof. Warrington Yorke, whose recent untimely death was also deplored by other speakers. Yorke was the first to examine scientifically by controlled experiments the practice of trying to sterilize a malarial infection by giving quinine in very large doses for a long period. He made three outstanding observations. The first was that quinine, however and whenever it is given, does not prevent infection from the bite of mosquitoes carrying malaria. The second was that, at the onset of the primary attack, quinine has no action at all until a good many parasites are present in the peripheral blood. The third was that quinine, however and whenever it is given, does not prevent malaria from relapsing. The therapeutic value of quinine and of the other main antimalarial compound mepacrine ('Atebrin') lies in their power to prevent the infection from developing into the clinically recognizable disease (suppressive treatment or prophylaxis) and to cut short the actual attacks of the disease (curative treatment). Although it is not possible to kill off all the malaria parasites in the body, and although, when treatment has ceased, they will sooner or later reappear causing a relapse, complete cure will eventually be produced by the development of immunity in the patient after a number of attacks have occurred. To control the clinical manifestations of the disease in this way, quite small doses are sufficient, for example, 10 grains of quinine or 0·1 gm. mepacrine given three times a day. Doses larger than these produce no greater therapeutic result (apart from the 'loading' dose mentioned below) but only exert a toxic influence on the patient, who exchanges the poison of the parasite for that of the physician.

The explanation of these limitations on the action of antimalarial drugs must lie in a more complete knowledge of the biology of the malaria parasite. As is well known, there is an asexual cycle in the blood of man in which the parasite (trophozoite) gradually enlarges and then divides (schizogony) into 16 or 32 small forms, each of which enters a new blood corpuscle and becomes a new trophozoite; in benign tertian and malignant subtertian malaria this cycle occupies forty-eight hours. There is also the invertebrate cycle, starting from the sexual cells (gametocytes) swallowed by the mosquito, which conjugate and form cysts in the insect's stomach; these cysts liberate countless smaller forms (sporozoites) which pass into the salivary glands and are inserted into man again when the mosquito bites; this cycle occupies about ten days. These two cycles have been known for forty years, but there is considerable obscurity as to the stages which occur between the injection of the sporozoites into the new host and the appearance of parasites (trophozoites) in the blood; in human infections this latent period occupies about two weeks. The work of James, Raffaele and others has shown that in certain types of bird malaria (due to *Plasmodium gallinaceum* and *P. relictum*) the sporozoites first develop in endothelial cells and macrophages, and not in the red blood corpuscles (erythrocytes) which form the host cells for the well-known asexual cycle of trophozoites and schizonts mentioned above. These new forms are known as the 'exoerythrocytic' parasites. Presumably they ultimately give rise to the ordinary trophozoites. They are almost completely resistant to the action of the antimalarial drugs known at present; in young birds they often reappear after the main wave of the blood infection has been overcome, and they cause death from massive growth in the capillaries of the brain and other organs. The occurrence of such exoerythrocytic forms in human malaria would explain many of the limitations of drug therapy described above, but unfortunately such forms have not yet been demonstrated. Col. James expressed his belief that they would eventually be found in man, but other speakers were more sceptical.

Be that as it may, the importance of intensive research on the biology, chemotherapy, and other aspects of the malaria parasite ought to be clear to all. In the War of 1914–18, malaria was an important military factor, and apparently it looms large in this War also. According to a recent broadcast by a member of the Australian Government, 80 per cent of the Australian troops who were landed in New Guinea went down with malaria. Although the details about other localities are rightly withheld by the authorities, it requires little imagination to visualize the great handicap to military operations and the great losses in men's efficiency and lives which this disease must be causing. Money devoted to the search for weapons to combat such a deadly menace is money well spent. Unfortunately, this truism has not been properly appreciated in Great Britain during the last thirty years, and support for such research has been limited, etiolated, and spasmodic. The sums spent on the conquest of malaria have been insignificant compared with those employed in trying to persuade people to change their brand of cigarette, or to alter their opinion about the nutritive value of beer. This is the more surprising since so many British Colonies lie in the tropics; and non-British have been apt cynically to express surprise that the wealthy British Empire, which probably suffers greater harm from malaria than any other community in the world, has been content to depend on the Dutch of Java for its quinine and on the German chemists for its synthetic antimalarial compounds. Colonel James concluded by hoping that this sorry state of affairs would be remedied in the future.

The next speaker, Dr. F. Hawking, described the valuable contributions made by Prof. Warrington Yorke to the chemotherapy of trypanosomiasis (sleeping sickness). By devising a simple technique for maintaining trypanosomes alive *in vitro*, he made it possible to study the action of drugs on the parasite without the complications and obscurities due to the intervention of the animal host. By this means Yorke showed that arsenicals exert a direct action upon the trypanosomes. Further work showed that normal trypanosomes actively absorb the drug, which becomes concentrated in the parasite and eventually poisons it. On the other hand, trypanosomes which have become arsenic-resistant or 'arsenic fast' fail to absorb the drug and so they survive. This explanation of the resistance of arsenic-fast trypanosomes, which had been postulated by Ehrlich on theoretical grounds, thus received its experimental verification. Yorke's last big contribution to chemotherapy was the discovery (in collaboration with Dr. H. King, Dr. A. J. Ewins and others) of the diamidine compounds such as propamidine:



These compounds are very active in the treatment of human trypanosomiasis, but the dose is limited by their toxicity; moreover, they do not penetrate the central nervous system, so that infections which have reached the brain cannot be sterilized. Accordingly it is probable that they will not replace the compounds at present in use, namely, tryparsamide and suramin (Bayer 205). On the other hand, they have proved very valuable in the treatment of kala azar, especially in the case of the resistant type which occurs in the Sudan, and this will probably prove their most important field of use. They are also effective in the treatment of babesiasis of dogs and other animals. Recently through the work of Fuller, and of Thrower and Valentine, propamidine has been found to exert a powerful action against bacteria and it has been employed with much success as a dressing for burns and other superficial wounds.

The greatest triumph of modern chemotherapy has been the discovery of the sulphonamide compounds, following the description of prontosil, by Domagk in 1935. Many of the bacterial infections of temperate climates which respond to these compounds occur in the tropics also; and sulphonamides have been invaluable in the Colonies in the treatment of pneumonia, cerebrospinal meningitis, gonorrhœa and other conditions. Among the infections more specifically tropical which are cured by these drugs, the chief one is bacillary dysentery. Dysentery is one of the four or five major infections of the tropics, and the introduction of sulphaguanidine by Marshall in 1940 has revolutionized its whole treatment. Previously the physician could apply only palliative measures, and the recovery of the patient depended mainly on the power of his constitution to overcome the invading micro-organisms. Now, the infection can be cut short in its early stages by a direct attack upon the offending bacilli. Dysentery has affected many of our troops in the Middle East, although the incidence has been kept much lower than it was in the War of 1914–18 by strict measures concerning the disposal of fæces and fly control. The use of sulphaguanidine has cut short the period spent in hospital, avoided much chronic invalidism and saved many lives. Yet another major disease has been brought under the control of the sanitary inspector to prevent it, and of the physician to cure it.

Another disease, more dreaded but less common, which responds to sulphonamide therapy is plague. In 1941 there was an epidemic in Nairobi, involving more than 240 patients, and Plum found that sulphapyridine given in large doses to early cases produced a dramatic improvement in their condition; if the treatment was not given until later, the infection was often too far advanced for the patient to be saved. Unfortunately other important infections of the tropics such as undulant fever (due to *Brucella melitensis*), typhus and typhoid are not affected by sulphathiazole and similar compounds.

Sulphonamides have a moderate action against human malaria, an action which is greater on malignant subtertian than on benign tertian. But since this action is less intense than that of the drugs at present in use (quinine and atebrin), its existence is of little practical importance at the present time, although it forms the starting-point for chemotherapeutic research which may eventually yield more active remedies.

The older forms of chemotherapy, such as those for malaria and for sleeping sickness, have something to learn from the newer principles which have been evolved from experience with sulphonamides. For one thing, the rational use of synthetic drugs is greatly facilitated if their blood concentration can be estimated and the dosages regulated accordingly. In the case of suramin (Bayer 205, antrypol) used for sleeping sickness, this is already possible through the work of Prof. A. C. Wormall; and the treatment of Europeans affected with the disease ought to be controlled in this manner, in order to avoid the disastrous relapses which may occur in patients who fail to retain the compound in adequate amounts. In the case of mepacrine (atebrin) used for malaria, methods will shortly become available, and then revision of the doses accepted at present may be necessary. A second principle derived from experience with sulphonamides is the rule of starting treatment with a large initial 'loading dose'. In this way, the unnecessary delay in raising the blood concentration to its effective level by a gradual accumulation of equal small doses can be avoided. Such a practice might well be adopted when mepacrine is administered for an acute attack of malaria. Instead of giving the customary course of 0·1 gm. three times a day for five days, in which case an effective concentration in the blood is probably not reached until the second day, it was suggested that the first dose might well be 0·6 gm. (or even 0·9 gm.) and that subsequent doses should be correspondingly reduced. It was also pointed out that although intramuscular injections of mepacrine are sometimes necessary, and although they are effective in getting the drug into the blood rapidly, they always cause a certain amount of necrosis at the site of injection, and should be avoided whenever possible.

Other speakers in the discussion described their own experiences with drugs and tropical diseases. Dr. H. M. Hanschell said that propamidine exerted a powerful curative action on infections of *Trichomonas vaginale* or of Ducrey's bacillus, but it was not more effective than the remedies already in use, and it often caused toxic symptoms; consequently it was not likely to be adopted for routine use in these diseases. He defended the synthetic chemists against some of the slurs cast upon them, saying that if they were expected to produce new drugs against infections, they ought to be given more information about the biology of the micro-organisms; this information could be gained only by more extensive research upon the malaria parasite and other offending Protozoa and bacteria.

Prof. K. B. Williamson mentioned some personal experiences with malaria in Malaya.

Major J. W. Howie, who had recently returned from Nigeria, described observations on soldiers taking quinine. Some persons failed to absorb the quinine completely in the intestine, or they got rid of it from the body with abnormal rapidity, and these persons were not properly protected by prophylactic quinine against the onset of attacks of malaria, nor were they readily cured by it when quinine was given for their fever.

Dr. W. D. Nicol brought forward observations made by himself and Mr. P. G. Shute at the Ministry of Health's Malaria Laboratory at Horton. Suitable doses of mepacrine given to four volunteers had prevented all infections from the bites of mosquitoes infected with subtertian malaria. In these cases, mepacrine had acted as a true prophylactic, destroying the sporozoites which the insect injected.

Dr. A. R. D. Adams spoke as one who had long been associated with Prof. Warrington Yorke, to whom he paid high tribute. The diamidine compounds had been used for the successful treatment of several cases of Indian kala azar at the Liverpool School of Tropical Medicine and no toxic complications had been encountered.

Major-General A. G. Biggam was able to give more cheering information about the other diseases of our forces in the tropics. The use of sulphaguanidine for the treatment of bacillary dysentery has been most satisfactory, and in most patients the progress of this disease is rapidly cut short. Succinyl-sulphathiazole (sulphasuxidine) is equally effective and satisfactory, although presumably the supply is more limited. Sulphapyridine and sulphathiazole are effective therapeutically, but they are more likely to cause toxic effects (vomiting and blockage of the urinary passages). Sulphanilamide is not effective. Succinyl-sulphathiazole has also been tried against typhoid fever; against the infection itself it is powerless, but it may help to prevent distension, although this is not certain. Kala azar in the Sudan responds well to stilbamidine (introduced by the late Prof. Warrington Yorke), but unless the solution is freshly prepared toxic reactions may occur. Tropical ulcers which often occur on the legs, and which are a most important cause of disability among native workers, have been much improved by the local application of penicillin, although presumably the supply is too limited for this treatment to be used extensively. Relapsing fever due to *Trep. recurrens* has caused trouble in Abyssinia and the Middle East; in some places, the response to neo-arsphenamine has been disappointing, and stovarsol, tryparsamide or bismuth have been more satisfactory. When the medical history of the present War can be described in full, because peace has come, it will include many interesting features. F. HAWKING.

ANTOINE LAURENT LAVOISIER, 1743–1794

By PROF. J. R. PARTINGTON, M.B.E.
Queen Mary College, University of London

ANTOINE Laurent Lavoisier, the architect of modern chemistry, was born in Paris on August 26, 1743. His father was an advocate and his mother the daughter of an advocate. The fortunes of the family of Lavoisier had progressed from employees in the postal service, through trade, to the legal profession, and although the father was not wealthy, the maternal grandmother had ample means and arranged for the boy's education. He attended as a day scholar at the famous Mazarin College in Paris, then notable in providing excellent teaching in science. Here he remained to the age of seventeen, when he began to prepare to enter the profession of law. His teachers, Guettard in geology, Bernard de Jussieu in botany, and especially Rouelle in chemistry, had, however, implanted in him a love of science. At first he was most attracted to mathematics and meteorology. He acted for three years as assistant to Guettard in a survey for a geological map of France. In the intervals of the necessary journeys he wrote an essay for the Royal Academy of Sciences, which had offered a prize for a description of the best method of lighting the streets of a large town. Lavoisier's essay did not gain him the prize, but he received a gold medal and the honour of having his essay published.

This early association with applied science was to continue throughout his life, and he later carried out a very large amount of work in the service of the French Government. The latter, during the early part of the seventeenth century, and in association with the Royal Academy of Sciences, had taken a keen interest in the application of science to arts and industries, and the spirit of the organization of knowledge which found its expression in the "Encyclopædia" was also manifested in the publication of several large and richly illustrated volumes dealing with various trades. The idea that it is a matter of political importance to have existing knowledge summarized and rationalized for the public benefit is, therefore, not a new one, and it found extensive and fruitful application in pre-revolutionary France. The six large volumes of the collected works of Lavoisier, published in the period 1864–93, are largely devoted to his many investigations on applied science, such as the manufacture of gunpowder, and he gave a large amount of time and energy to such public services.

The Royal Academy of Sciences, founded by Louis XIV in 1666, elected Lavoisier to membership in 1768, at the early age of twenty-three. In 1764 he had published a paper on gypsum, but at this time he had done no scientific work of real importance. In 1768 he also entered the *Ferme Générale*, an association which, in return for a sum paid to the Government, fixed periodically, had the right to collect from the taxpayers whatever sum they could be induced to part with. As might be expected, the members of the *Ferme* varied considerably in their methods, and there was some harsh administration, so that the association as a whole laid up for itself a growing store of hatred and contempt which was later to play a large part in the Revolution. Whatever pretext was offered for the execution of Lavoisier, it was actually his association with the *Ferme* which sealed his fate. He carried out his duties honestly and, we may be sure, humanely, but he also made large profits. These enabled him to carry on very expensive researches, and his work is noteworthy in the use of elaborate—often over-elaborate—apparatus, and much of it was outside the means of other scientific men.

In 1771 Lavoisier married Marie Anne Pierrette Paulze, the daughter of a member of the *Ferme*, then in her fourteenth year. Madame Lavoisier, although so young, set herself the task of becoming an assistant and amanuensis in his scientific work, and besides being a capable and affectionate wife she also, with her notable linguistic and artistic ability, gave him very effective help in his researches and publications. The charming illustrations in his famous "Traité élémentaire de Chimie" (1789) are from drawings which she made.

The scientific work of Lavoisier has a marked character. He discovered no new substances, devised no really novel apparatus, and worked out no improved methods of preparation. He was essentially a theorist, but a theorist of a most original, drastic and revolutionary kind. It must not be supposed that scientific chemistry originated with him, although he undoubtedly gave it a new form, which it still carries. From the beginning of the seventeenth century, with the work of such men as Van Helmont, Boyle, Glauber, Lemery and Stahl, a very important body of systematized knowledge had grown up which constituted a true science of chemistry. The underlying theory, when Lavoisier began his work, was the doctrine of phlogiston. This was primarily intended to explain the phenomena of combustion and the calcination of metals. The theory assumed that combustibles and metals contained a common, identical, and transferable entity called phlogiston, which they lost when burnt or calcined; the theory was also widely extended to other chemical phenomena. There had also been good quantitative work, notably that of Black (whose researches served as a model for Lavoisier's) and Bergman. The focusing of attention on combustion phenomena by Lavoisier, and the overwhelming importance which he conferred on oxygen, must not be allowed to obscure the fact that a large part of chemistry lies outside this region, and that much fundamental and important research had already been carried out in this wider field.

Lavoisier's great merit lay in his capacity of taking over experimental work carried out by others (whose claims he, unfortunately, did not always sufficiently recognize or admit in his published memoirs or his books), and by a rigorous logical procedure, based on the results of quantitative experiments which he himself made, of expounding the true explanation of the results. This explanation, that combustion and calcination consist in the union of the combustible or metal with oxygen, found much opposition among the older and more conservative chemists in all countries, but after the publication of his "Traité" in 1789, it quickly gained acceptance everywhere, no less rapidly in Germany, the home of the phlogiston theory, than elsewhere. This was, however, only a part of the story. The appearance of heat and light, or fire, in combustion also required explanation, and Lavoisier did this by assuming the existence of imponderable elements, caloric (the matter of heat) and light, which in their way bore a strong resemblance to the old phlogiston.

This work began in 1772, and after the discovery of oxygen by Priestley in 1774 it proceeded apace, a large number of memoirs being published by Lavoisier after presentation to the Royal Academy of Sciences. The experiments of Cavendish on the formation of water from hydrogen and oxygen, published in 1784, enabled Lavoisier to complete his so-called Anti-phlogistic Theory, and they played a decisive part in leading to its acceptance. The assumption made by Lavoisier that all acids contain oxygen was an error which was not rooted out until after 1810, but his surmise that the earths are oxides of unknown metals received a brilliant confirmation in Davy's isolation of the alkali and alkaline earth metals in 1807–8. The alkalis themselves were not regarded by Lavoisier as oxides of metals, although he was convinced that they were not true elements.

A great service given to chemistry by Lavoisier was the institution, with his colleagues, at the instigation of Guyton de Morveau, of a scientific nomenclature, published in 1787. The principles laid down are still in use.

The same year, 1789, which saw the publication of Lavoisier's revolutionary "Traité de Chimie" witnessed also the outbreak of the French Revolution. During its earlier stages Lavoisier continued to carry out work for the State, but he was soon singled out for attack. The impulse came from Marat, whose theory of fire had been unfavourably criticized by Lavoisier. The series of pretexts by which he was brought into popular discredit cannot be detailed; in the final phase nothing worse could be brought against him than a charge that he had, as a *fermier*, adulterated tobacco with water. In his trial, in which the president of the court was Coffinhal, the plea that his scientific services had been valuable to the State was rejected in the words: "The Republic has no need of savants; justice must take its course". Although Lavoisier's association with the *Ferme* was the real reason for his downfall, this could not legally be brought against him, since the Tribunal had no power to deal with crimes of the pre-Revolutionary period. With a will, however, a way can be found, and on the petty accusation mentioned the great Frenchman was condemned, and on May 8, 1794, he suffered the penalty of death by the guillotine.

In 1795 his property, previously confiscated, was restored to Madame Lavoisier, who lived until 1836; in 1806 she published some memoirs of her husband. His complete works were, as mentioned, published under the auspices of the Royal Academy of Sciences in the period 1864–93. The general contributions of Lavoisier to chemistry are well known, and he has received an ample and generous recognition and admiration, which are well deserved. It is fitting, however, on the date of the bicentenary of the birth of this distinguished man, once more to pay a tribute to his great and enduring services to science in general, and particularly to chemistry.

ARCHÆOLOGY AND ANTHROPOLOGY IN INDIA

By Prof. J. H. HUTTON, C.I.E.
University of Cambridge

It is just about a hundred years since an association began to be formed between archæology and anthropology which has proved very fruitful to both these branches of human knowledge. So necessary are they one to another that no general course of instruction in one can well afford to ignore the other, and the union of the two in a common tripos in the University of Cambridge, due no doubt in the first instance to the foresight and influence of Haddon and Ridgeway, has proved incontestably satisfactory. But this association between archæology and anthropology has been generally limited to prehistoric archæology on one hand, and on the other to the more or less historic schools of anthropological thought; for the more extreme, at any rate, of the so-called functionalist anthropologists profess to repudiate inquiry into the past history of the societies and institutions which they study. In his presidential address to the Section of Anthropology and Archæology at the thirtieth Indian Science Congress held in Calcutta in January of this year, Dr. N. P. Chakravarti, of the Archæological Survey of India, seeks to extend this association by turning epigraphy to the service of anthropological inquiry.

The period of Indian history from the third century B.C. to the sixth century A.D. is indeed obscure enough. It was a period of minor immigrations between that of the Rigvedic 'Aryans' in the second millennium B.C., and the influxes of Islamic conquistadors which started about the ninth century A.D. with the Arab incursions into Sind, and continued until the establishment of the Mogul Empire. It was the period of the Yavanas, Pahlavas, Sakas, Kushāns and Huns, and inscriptions can at least throw some light on the areas that these invaders occupied, and, in the case of the Kushāns, at any rate, whence they came. Further, the way in which they adopted the religion of the country they settled in is clearly indicated by their votive inscriptions. Thus a pillar in Gwalior State records the dedication of a shrine to Krishna by Heliodorus son of Dion, ambassador of Antialcidas, the Hellenic king of Taxila, and describes the dedicator as a 'follower of Vishnu'. In a similar way one of the Kushān rulers is shown by his coins to have been a Shaiva.

Inscriptions of the same period likewise throw light on peoples long settled in India, such as the Andhras, whose rulers can be shown to have intermarried with Saka invaders, and Dr. Chakravarti mentions inscriptions of the Ishvaku family of southern India which show clearly that, although it is prohibited by the strict Hindu law, cross-cousin marriage was practised even in ruling families. Other inscriptions perhaps go to indicate an identity of race between ruling families at this period in Assam and in Gilgit, a point which calls up the reflexion that the game of polo was first known to us in Gilgit and in the distant State of Manipur on the eastern frontier of Assam, whence it was introduced into British athletics, though it is the Balti and not the Manipuri name for it which we use. The sum total of information available to ethnographers from inscriptions may not be great, but such as it is, it is likely to be useful and suggestive.

Dr. Chakravarti also dwells on the subject of writing in general. He describes four stages, the first three of which he calls mnemonic, pictorial, and ideographic, while by the fourth the alphabetic is clearly intended. But he is not justified in describing them as successive evolutionary stages. The first two may no doubt be regarded as both contributing to the invention of writing, but there is no evolutionary series here. The alphabet, again, for all true alphabets seem to have a single source, though it has a pictographic origin, does not by any means evolve from an ideographic form of writing. On the contrary, though the Japanese in adopting the Chinese script may tend to give some of its ideograms a purely alphabetic value, Chinese, which is ideographic, has no alphabet. The nature of the Mohenjodaro script is still undetermined, and it is probably impossible to say whether it is pictographic or ideographic. It seems limited to seals, and may have been a purely commercial device for marking goods. Dr. Chakravarti mentions that many theories of its interpretation have been put forward without carrying conviction, but he does not mention specifically Hevesy's association of it with the Easter Island script. Hevesy's view has been severely criticized by Dr. Métraux of the Bernice P. Bishop Museum; but Heine-Geldern has found equally remarkable parallels between both the Mohenjodaro and the Easter Island symbols and those used in one of the earliest forms of Chinese. If he and Hevesy are right—a view not very easy to accept—it is possible that the language of Mohenjodaro may prove to have belonged not to the Dravidian but to the Austric family, and so to have affinities with the Munda tongues.

Dr. Chakravarti's address has been taken in reverse order. It remains to mention a subject that he touched upon at the start: that is, the losses suffered by anthropology in India during the past year through death. Of the names he mentions, only two are Indians, one an anthropologist, the other an archæologist. Rai Bahadur Sarat Chandra Roy was well known to anthropologists outside India as a pioneer in Indian ethnography. His monographs on various tribes of Chota Nagpur were among the first of their kind and have contributed very greatly to our knowledge, and understanding, of those tribes, to the promotion of whose welfare he gave so much of his life. It was the oppressions and hardships suffered by the Munda tribe at the hands of aliens that first moved him, as a young lawyer, to study their language and customs the better to sponsor their causes. Furthermore, he founded and edited *Man in India*, which is still the only periodical in the British Empire, probably, given exclusively to anthropology, but without the backing of any scientific or educational body behind it. Roy was also something of an archæologist, and excavated a number of prehistoric sites in Chota Nagpur, particularly sites associated with the Asurs. Rai Bahadur Ramaprasad Chanda was probably more of an anthropologist than Roy was of an archæologist, for he started as an anthropologist before he gave himself to archæology, working on anthropometry and on physical data as well as on cultural. He was an early critic of Risley's theories of brachycephaly in India, but probably his most important contribution to anthropology came from his profound knowledge of early Sanskrit literature, which he applied to the interpretation of cultural problems of prehistoric India. Indian anthropology is indeed unfortunate in losing both Sarat Chandra Roy and Ramaprasad Chanda in the same year.

OBITUARIES

Baron Gerard de Geer, For.Mem.R.S.

BARON GERARD JACOB DE GEER, whose death occurred on July 24, was born in Stockholm on October 2, 1858. Professor of geology at the University of Stockholm from 1897 until 1924, he ended his days as founder-director of the University's Geochronological Institute. There is more than one Baron de Geer in Europe. The originator of the branch of the family from which the famous geologist arose went to Sweden from what is now Belgium at the request of King Gustavus Adolphus early in the seventeenth century, and there started a large iron and steel industry. In after years successive de Geers played a great part, not only in the industry of Sweden, but also in her science and politics. Gerard's father, Louis, was Prime Minister for twelve years, and Gerard himself was a member of Parliament from 1900 until 1905. Recognition in Great Britain of his scientific eminence has been shown by award of the Wollaston Medal of the Geological Society in 1920, and by election to the foreign membership of the Royal Society in 1930.

De Geer's great achievement, according to very general acceptance, has been his deciphering of a year-chronology "backwards into a part of the earlier or Palæolithic Stone Age". We have here something much more precise than any chronology so far based upon the erosion-rate of Niagara, or the decay-rate of uranium. The time unit employed is the year, just the same as that which figures so prominently in our school history books.

Recognition of annual rings of growth in trees of temperate regions is an old, old discovery; but realization of similar annual layers of growth in certain favourably situated outer portions of the earth's mineral fabric was little more than a dream, until, in 1878, it came independently into the mind of de Geer. This happened during his first geological field work in the Stockholm region. From then onwards to the end of his life, during the greater part of which time he was helped by assiduous collaborators, de Geer strove to confirm the annual nature of the layering of the varved clays of the Baltic; and thereafter to derive from the chronometer thus afforded a maximum of information regarding dates of events which had happened during Late Glacial and Post-Glacial times in Sweden and elsewhere.

The term 'varve' means a cycle. The varved clays, in large measure of somewhat sandy character, are laminated deposits, in which each full layer has a more sandy basal portion merging upwards into a skin of pure clay—which latter is followed abruptly by the sandy base of the next succeeding varve. The Baltic varved deposits were formed in a freshwater portion of the Baltic Sea, deeper and more extensive than to-day owing to submergence, into which the Scandinavian ice-sheet still projected during a retreat determined by frontal and other melting. Almost any observer would be prepared to admit that individual varves record rhythmic repetitions of some melt plus non-melt episode, which affected the neighbouring ice-sheet. He would also recognize an inherent probability that in each episode the melt portion covered a whole summer and the non-melt a whole winter, because, where flood waters are provided by melting of large expanses of snow and ice, rather than by rainfall, they tend to adopt a seasonal duration. To turn this probability into something near certainty was de Geer's fundamental task. As president of the memorable International Geological Congress that met at Stockholm in 1910, he presented his case in an address and also less formally during a wonderful afternoon excursion. His argument was as follows.

There are in the Stockholm district two other sets of glacial phenomena which independently seem to record successive seasons. The first is a series of rock-fragment ridges, obviously frontal moraines. One naturally interprets them as marking winter re-advance positions of the ice front, which, owing to preponderant summer melting, was on the whole retreating. The second is a series of great mounds of sand and gravel, strung like giant beads in a chain running at right angles to the moraines. Here the inference seems justified that each mound represents the gradually retreating mouth-position of a persistently renewed summer sub-glacial river, discharging into the standing water of the Baltic. De Geer assured us that moraines, gravel mounds and varves are all convincingly related. Thus usually only one gravel mound is situated between each successive pair of moraines, as one would expect, since there is only one summer between any two successive winters. Also, in proceeding northwards across the moraines (keeping away from complications near the gravel mounds, which make observation difficult), one finds that the bottom varve of the local varve succession is always lost each time one crosses a morainic ridge.

This last claim obviously involves identification of individual varves. De Geer found on graphing his records of thickness for successions of varves exposed in neighbouring brick pits that he obtained curves of considerable character, with diagnostic groupings of maxima and minima. These curves he interpreted as in large measure a record of climatic vicissitudes. It was clear, at any rate, that they allowed of identification of certain well-characterized varves from pit to pit. Supposing that south of a particular moraine de Geer had established that the fifth varve from the bottom was of abnormal thickness, he always found that immediately north of the same moraine it was the fourth varve from the bottom that showed this abnormal character.

The above is only an outline of the beginning of de Geer's work. One remembers how he connected graph with graph, until he had compiled a year-and-climate record reaching from the time when glaciers melted from the site of Stockholm right on to the present day. One remembers, too, his selection of a year 0, when, according to his chronology, the Glacial Period terminated and Recent Times began. This year 0 is marked locally by a monster varve, attributed to the catastrophic drainage of the glacially impounded portion of Lake Storsjön on severance by melting of its retaining glaciers. At Storedan in West Ragunda the resultant varve measures 980 mm. of clayey sediment. Again, one remembers time correlations with Iceland and the Great Lakes region of North America. One also remembers how de Geer's technique of graphing successive varve thicknesses has been applied with striking success to extracting history from the annual rings of trees, whether pines in Scandinavia or Sequoias in California. Finally, there is his observation that glacial varves are only found where summer floods have entered standing fresh water. Various explanations of this limitation of glacial varves to fresh water have been advanced.

In brief, de Geer created and maintained throughout his life-time a new sub-science. Fortunately, his main results are summarized in "Geochronologica Suecica: Principles", published in two fine volumes in English (Stockholm, 1940). This great work is dedicated to his wife, Ebba Hult de Geer, "since more than thirty years my indefatigable scientific partner during all expeditions, every kind of field-work and redaction unto the last proof-leaf". Those of us who are interested in geochronology know how much original research has entered into this invaluable and indefatigable partnership.

E. B. Bailey.

Mr. Hugh Whistler

By the death of Mr. Hugh Whistler at the early age of fifty-three, ornithology—and especially Indian ornithology—has lost a man of science who had already made his mark but who would undoubtedly have added greatly to his reputation had he been spared.

Hugh Whistler was born on September 28, 1889, and died on July 7, 1943. He was educated at Aldenham and when twenty years old entered the Indian Imperial Police. Choosing the Punjab as his Province, in a very short time his keen observation of Nature enabled him to add much to our knowledge of the distribution of birds in that and the adjoining Provinces.

In 1925 he married the Hon. Joan Ashton, daughter of Lord Ashton of Hyde, and had one son and one daughter. In 1926 he retired from the Indian Police to Battle, Sussex, where his ancestors had lived for many generations. Here he took a keen interest in local matters. He was on the Committee of the Sussex Archæological Society.

His outstanding work is, undoubtedly, his "Handbook to Indian Birds", which, published first in 1928, has already passed through three editions, each an improvement on the last. Of more scientific importance, however, were his papers on the "Scientific Survey of the Eastern Ghats" (in collaboration with N. B. Kinnear); his "Hyderabad State Ornithological Survey" (in collaboration with Salim Ali); and his "Ornithological Survey of the Jodhpur State".

His first article was published in the *Bombay Natural History Journal* (22; 1911), a note on "the distribution of *Passer pyrrhonotus*", and from that time up to the date of his death he contributed sixty to seventy articles to that journal. In addition, after his retirement in 1926, he wrote frequent notes and articles for the *Ibis* which, though brief, were of considerable value.

In his notes to the Bombay journal and the *Ibis* he recorded additions to the Indian avifauna of *Motacilla alba leucocephala*, *Emberiza calandra*, *Luscinia suecica discessa*, *Panurus biarmicus* (*russicus*) and *Pitta megarhyncha schlegel*, while he also described as new *Zosterops palpebrosa salimalii*, *Pomatorhinus horsfieldi maderaspatensis* and *Passer domesticus parkini*. In recognition of his work the following birds, among others, were named after him: *Garrulax albigularis whistleri*, Stuart Baker; *Tarsiger chrysaeus whistleri*, Ticehurst; *Niltava sundara whistleri*, Ticehurst; *Horeites brunnifons whistleri*, Ticehurst; *Seicercus burkii whistleri*, Ticehurst; *Parus rufonuchalis whistleri*, Stresemann and *Sitta Himalayensis whistleri*, Delacour.

Whistler's work was characterized more than anything else by his "capacity for taking pains"; by his extraordinary care over the most minute details, and by his methodical procedure in everything he undertook.

E. C. S. B.

WE regret to announce the following deaths:

Mr. W. H. Hogg, since 1933 principal of Seale-Hayne Agricultural College, on July 29.

Sir Ralph Jackson, formerly chief veterinary officer in the Ministry of Agriculture, on August 2, aged seventy-one.

Prof. T. J. Jehu, emeritus regius professor of geology in the University of Edinburgh, on July 18.

Dr. C. J. S. Thompson, M.B.E., honorary curator of the Historical Collection of the Museum of the Royal College of Surgeons, aged eighty.

NEWS and VIEWS

Retirement of Prof. Raymond C. Archibald

FEW scholars have a larger circle of personal friends among mathematicians on both sides of the Atlantic than Prof. Raymond C. Archibald, whose impending retirement is announced from Brown University. An official position in the American Mathematical Society has brought him into touch with every active mathematician of this century in America, while in the course of frequent and extensive journeys in Europe to ransack bookshops and visit libraries, he has taken every opportunity to make the acquaintance in their own countries of the men and women whose writings he already knew. Enthusiastic, persuasive and learned, he has made the mathematical section of the library at Brown University one of the finest to be found anywhere, and he has created there for mathematicians the surest source of bibliographical and biographical information in the world.

Prof. Archibald's published works include the definitive edition of one of Euclid's minor treatises, and the semi-centennial history of the American Mathematical Society, the latter a heavily documented volume incorporating twenty-seven biographical sketches. He is the author of a vast number of bibliographical articles, distinguished for an impersonal and uncritical thoroughness that conceals the toil and the knowledge that go to their compilation, and is, it must be confessed, sometimes carried to excess, for Archibald's modesty will not allow him to believe that if only, like Keynes and Muir, he would sometimes tell us after reading a paper that no one need ever read it again, others would gladly accept his judgment and be spared the tedium of making the discovery for themselves. Prof. Archibald has served for long periods on a number of editorial boards, and is now editing for the National Research Council of the United States the youngest of mathematical journals, *Mathematical Tables and Aids to Computation.* To Prof. Archibald, retirement will not spell indolence. It need scarcely be said that his expert advice will still be available in the library which he has made famous, he is continuing in his latest editorship, and he hopes to devote the time saved from routine to perfecting the organization of a library of English and American poetry and drama which he has been developing at Sackville since 1905 in memory of his mother. Increased leisure, if miraculously he achieves it, will mean enhanced opportunities to cultivate a second passion, for he is not merely a lover of music but also a musician of exceptional skill, who might easily have become a professional violinist and remained an amateur in mathematics. May he long enjoy a strenuous life.

Higher Education in the British Colonies

THE Colonial Office announces that the following Commission is to inquire into higher education in the Colonies: Sir Cyril Asquith (chairman); Sir Donald Cameron, formerly Governor of Nigeria; Prof. A. M. Carr-Saunders, director of the London School of Economics; Prof. H. J. Channon, professor of biochemistry, University of Liverpool; Sir Fred Clarke, director of the Institute of Education, University of London; Mr. J. F. Duff, vice-chancellor of the University of Durham; Lord Hailey, chairman of the Colonial Research Committee; Prof. A. V. Hill, M.P., secretary of the Royal Society; Sir James Irvine, vice-chancellor of the University of St. Andrews; Sir Richard Livingstone, president of Corpus Christi College, Oxford; Dr. R. Marrs, formerly principal of University College, Colombo; Miss L. H. Penson, professor of modern history, University of London; Miss Margery Perham, director of Colonial research, Nuffield College, Oxford; Prof. J. A. Ryle, professor of social medicine, University of Oxford; Dr. R. V. Southwell, rector of the Imperial College of Science and Technology; Dr. J. A. Venn, vice-chancellor of the University of Cambridge. The terms of reference of the Commission are: "To consider the principles which should guide the promotion of higher education, learning, and research and the development of universities in the Colonies; and to explore means whereby universities and other appropriate bodies in the United Kingdom may be able to co-operate with institutions of higher education in the Colonies in order to give effect to these principles".

A further commission of inquiry into higher education in British West Africa has been announced. It consists of Colonel Walter Elliot, M.P. (chairman); Prof. H. J. Channon, University of Liverpool; Mr. A. Creech Jones, M.P.; Mr. J. F. Duff; Sir Geoffrey Evans, of the Royal Botanic Gardens, Kew; Dr. Julian Huxley; Mr. K. A. Korsah, unofficial member of Executive Council, Gold Coast; the Rev. Ransome Kuti, headmaster, Abeokuta Grammar School, Nigeria; Miss E. C. Martin, vice-principal of Westfield College, University of London; Prof. B. Mount-Jones, vice-chancellor of the University of Leeds; Miss Margaret Read, acting principal of the Colonial Department, Institute of Education, University of London; Dr. E. H. Taylor-Cummings, medical officer of health, Sierra Leone; and Prof. A. E. Trueman, professor of geology, University of Glasgow. It is also to include a member with wide administrative experience in tropical Africa. This Commission is to report on the organization and facilities of the existing centres of higher education in British West Africa and to make recommendations regarding future university development in that area.

African Meteorological Workers

TRAINING of Africans in the Meteorological Department in Kenya was started some years ago and increasing numbers are now joining the Service. Most of the workers have been educated at African schools and have passed the Junior Secondary School Examination. An entrance examination to the Department ensures that the candidates have a reasonably sound knowledge of arithmetic, English, physics and geography. Sections of the Service include observing, clerical climatological work and printing. Africans trained for the Observing Section are liable to be sent anywhere in Kenya and a few have gone as far as Uganda and Tanganyika Territory. A course beforehand of a few months duration enables these men to read instruments such as thermometers and barometers. They learn to distinguish between the different types of clouds and to report weather visibility and wind force and direction. Training is also given in pilot balloon observations, and Africans have shown remarkable adaptability in this difficult task. The Climatological Section covers a wide field and here also Africans are not lacking in ability. Printing is a task to which the African takes readily, and all reports, summaries and rainfall bulletins are printed on the premises, as well as all the necessary forms for the Department. Rates of pay and facilities for leave are the same as for other Government Departments. Hours are also similar, except for the observers, whose duties must necessarily be irregular.

Integration of Research in the United States

Dr. R. H. HEINDEL, director of the American Library of the Office of War Information, has contributed to the May issue of *Agenda* an article "The War and Post-War Integration of Research Activities in the United States", which is of considerable general interest to scientific workers. The article gives a comprehensive picture of the extensive development of decentralized research in the United States, especially in science, to implement the war research programme, and should be read in conjunction with Dr. Karl T. Compton's Pilgrim Trust Lecture (NATURE, May 29, p. 601). The integration of Federal and non-Federal research facilities is a war problem of the highest importance in view of the limited number of specialists and the need for protecting the nation's research structure, now and in post-war reconstruction. The Federal Government has for many years been developing, with all kinds of responsible research agencies, patterns of procedure and co-operation which have proved useful during the War and should not be without value in considering the organization of research in Great Britain and in the British Commonwealth, and particularly the relations between Government research institutions and the universities. The types of investigation suitable for 'farming out' or contracting are almost unlimited. Contracting for research and co-operative programmes depend on the existing personnel, the fields of study, the nature of the problems, the structure of the official and private agencies and the community of agencies willing to serve the nation as a whole, and success here requires more coherence and direction in the formulated needs of the Government. Government demands for certain types of research may encourage within the universities and elsewhere a greater use of inter-departmental and inter-disciplinary approaches to research projects.

In regard to detail, Dr. Heindel refers to an impressive programme of research development and the most extensive use of contracting with substantial funds, centring about the Office of Scientific Research and Development, within the Office for Emergency Management, to which are attached an Advisory Council, the National Defence Research Committee and the Committee on Medical Research. One of the most successful contracts exists between the Public Roads Administration and the National Research Council for the Highway Research Board, while the U.S. Office of Education has also stimulated and participated in numerous co-operative research projects with State and private agencies. The Bureau of Foreign and Domestic Commerce has been extending its co-operation with university schools of business and departments of economics, and acts as a clearing house for business and economic research. Moreover, in the use it makes of the results of scientific study in its legislative duties and in its responsibility as the appropriating authority for the Federal research programme, Congress occupies an important place in the research structure of the nation. In this article, Dr. Heindel's map of research in the United States is not always as clear as it might be, but he indicates the right questions to which answers must be forthcoming if the machinery for co-ordination, for co-operation and contracting is to be used with success and the results of research conveyed to the proper people.

"Abstracts from Cancer Research"

THE problems of the nature and possible treatment of malignant disease are studied in many laboratories and results are published in different journals. It is difficult for any worker to keep in touch with all the published work. Excellent summaries of papers were published for many years in the *Cancer Review*, the publication of which was unfortunately suspended about ten years ago. Since then abstracts have been available in the *American Journal of Cancer*, which has now been replaced by *Cancer Research*. The "Abstracts from Cancer Research" are published separately and the first volume covers the year 1941. The summaries are grouped under the main headings of experimental research (including carcinogenic compounds, hormones, viruses, genetics, physical factors, radiation, chemosurgery, biochemistry and nutrition—chemotherapy, immunology, leukæmia, transplantation and tissue culture), comparative oncology, clinical and pathological reports, statistics and cancer control and public health. The production seems admirable and should be of great value to cancer research workers. This new journal is published in America by the International Cancer Research Foundation, but Prof. E. L. Kennaway and Dr. W. E. Gye arrange for the abstracting of articles appearing in publications in the British Commonwealth.

Laryngology and Folk-lore

IN a recent paper (*J. Laryng. and Otol.*, 57, 527; 1942) on this subject, Dr. J. D. Rolleston states that up to the time of Morgagni (1682–1771), who described several cases in which it was diseased, the larynx occupied a very subordinate place in pathology, its existence being almost ignored by ordinary students of medicine. On the other hand, there are several references in classical antiquity to popular methods of dealing with diseases of the throat, as can be seen by references to them in Celsus, Pliny, Marcellus Empiricus and Julius Modestus. In the Middle Ages a combination of folk-lore with orthodox practice is illustrated by the fact that Aetius of Amida (fourth century A.D.) recommended that after other methods had failed to remove a foreign body from the throat it should be invoked in the name of St. Blaise, the patron saint for diseases of this kind, "to come up or go down". In the eighteenth century, numerous popular terms, especially in Scotland, were given to a special form of laryngitis occurring in children, such as 'croup', 'croops', 'chock', 'stuffing' or 'rising of the lights'. As in the case of many other diseases and morbid conditions, folk-lore has only a few prophylactic measures compared with curative treatment, while its therapy can be grouped under animal remedies, plant remedies, patron saints and miscellaneous remedies.

Earthquakes Registered in New Zealand

DURING April 1943, eleven strong distant earthquakes were registered by the seismographs at Auckland, Arapuni, Christchurch, Kaimati, New Plymouth, Tuai and Wellington, New Zealand. The earthquake of April 6 registered at most of the New Zealand stations occurred at 16h. 07·1m. U.T. near latitude 32° S., longitude 70° W., according to the U.S. Coast and Geodetic Survey. This is mid-way between Illapel and Mendoza in Chile. The earthquake also registered at College, St. Louis, Ottawa, Sitka, Georgetown and fourteen other stations sending records to Washington. The earthquake of April 9 occurred at about 8h. 48·8m. U.T. from an epicentre as determined by the U.S. Coast and Geodetic Survey near latitude 19° N., longitude 145° E., which is in the Pacific Ocean west of Agrigan Island, one of the Marianas Islands. In this case the depth of focus was near 100 km. Additionally, twenty-nine local earthquakes and earth tremors were recorded. Five of these shocks reached intensity V on the modified Mercalli scale. The first, on April 6, was felt in the Wairoa region; the second, also on April 6, was felt near Hawkes Bay; the third, on April 7, was also felt near Hawkes Bay; the fourth, on April 15, was felt over the southern part of North Island, while the fifth, also on April 15, was felt at Manawatu and Wairarapa.

Food Situation in Sweden

ACCORDING to the *Anglo-Swedish Review* of July, comparison of Sweden's rations with those of foreign countries seems to show that the Swedish rations are surprisingly small. Three important products, however, namely, milk, potatoes and other vegetables, are not rationed but can be bought in unlimited quantities. Temporary visitors to Sweden who eat their meals at restaurants may think the food situation is more favourable than it really is. In a restaurant coupons are only required for butter, bread, most of the meat products and eggs. On the other hand, for Swedish households the coupon-free meat products play a very minor part, and their price is so high that they are almost beyond the reach of most consumers.

Space Heating

FOR his chairman's address to the Installations Section of the Institution of Electrical Engineers, R. Grierson took the subject of "British Climate and the Space-Heating Engineer" (*J. Inst. Elec. Eng.*, 90, Pt. 1, No. 29; May 1943) in which the means of assessing the thermal performance of space-heating installations on a rational basis rather than on the present empirical one are indicated. The address first reviews the basic factors involved in space-heating problems, then proceeds to discuss the internal temperatures required for maintaining the desired standard of thermal comfort, external temperatures, and temperature difference and degree-days. The address is printed in abstract in the *Journal*, but the complete text may be referred to in the Institution Library.

Utilization of Small Coals

THE British Coal Utilisation Research Association is arranging a conference on November 10 and 11 to discuss the problems related to the utilization of small coals with particular reference to the results obtained by the users of these fuels. It is known that a great body of valuable experience on the subject exists, and it is hoped, by means of the Conference, to make this experience available to those concerned, and by discussion to direct attention to the most practical and effective methods of utilization. The Conference has the full support and approval of the Fuel Efficiency Committee. There will be three sessions: November 10, at 2.30, on utilization of small coals and slurries; November 11, at 10, on utilization of fuels of high inert content; November 11, at 2.30, on the upgrading of fuels. Offers of papers for discussion at the Conference should be sent to the Conference Secretary, B.C.U.R.A., Rickett Street, West Brompton, London, S.W.6. The Conference will be open without charge to all interested, by tickets obtainable from the Conference Secretary. Papers will be circulated in advance and the proceedings confined to a discussion of the papers.

Searle's "Experimental Optics"

DR. G. F. C. SEARLE writes that additional accommodation for students attending the Cavendish Laboratory, Cambridge, has been obtained in the Geological Museum, and the task of transferring the optics class to that Museum has begun. Dr. Searle's "Experimental Optics", which is required for the course contemplated, is out of print, and Dr. Searle asks former pupils to offer copies of this book which they may have retained to the Laboratory. Letters should be sent to Dr. Searle before sending the books; the Laboratory will pay 16*s*. for each copy in fair condition.

Colonial Service Appointments

THE following appointments have recently been made in the Colonial Service: J. F. G. Wheeler to be marine biologist, Mauritius; J. C. Eyre, agricultural officer, Tanganyika Territory, to be senior agricultural officer, Palestine; J. Smith, assistant conservator of forests, Nigeria, to be senior assistant conservator of forests, Nigeria; J. E. Taylor, assistant conservator of forests, Nigeria, to be senior assistant conservator of forests, Nigeria; R. C. Burgess, lands officer and senior surveyor, Sierra Leone, to be director of surveys and lands, Sierra Leone; W. Harrison, surveyor, Nigeria, to be senior surveyor, Gold Coast.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Measurement of Anomalous Viscosity by the Capillary Tube Method

CAPILLARY tube viscometers have been in constant use over the past twenty years or so, for measuring the viscosity of a wide range of materials such as, for example, clay and flour suspensions, cream, honey, grease, paints, starch pastes, tar, etc., which are not true liquids[1]. The instrument usually takes the form of a Bingham plastometer (Fig. 1 *a*), an Ostwald viscometer (Fig. 1 *b*) or some modification of these types[2-6].

With the Bingham plastometer, an excess air pressure is usually applied above the surface of the material contained in the vessel *V*, thus forcing it through the capillary *C*, the pressure being measured by some form of manometer connected to *M*. If necessary, a correction is added to this pressure to allow for the hydrostatic head of liquid. Considering this viscometer as flow through two tubes of different bore, one large and the other small (radius R and r) and taking l as the length of the capillary and L the (mean) height of liquid in *V*, and if the pressure drop across *V* and *C* is denoted by P_v and P_c respectively, then

$$P_v \propto \eta L/R^4 \quad \text{and} \quad P_c \propto \eta l/r^4,$$

where η is the viscosity of the liquid. These expressions, which follow directly from Poiseuille's law, are valid for a true liquid since η is a constant. In practice, the dimensions of the apparatus are such that, with a true liquid, P_v is negligible compared with P_c and the calculations involved assume this to be the case.

For an anomalous liquid, however, these expressions for P_v and P_c are not necessarily valid, since η can no longer be regarded as constant; we then have

$$P_v \propto \eta_v L/R^4 \quad \text{and} \quad P_c \propto \eta_c l/r^4,$$

where η_v and η_c are the apparent viscosities (calculated from Poiseuille's equation) in the vessel and capillary respectively. Thus for liquids which show a decrease in apparent viscosity with increasing shearing stress or rate of shear (and such materials are fairly common), η_v may be very many times greater than η_c, since the rate of shear in the vessel is much lower than that in the capillary. It is clear, therefore, that under certain conditions it might be possible for P_v to become large compared with P_c, and since pressure, measured in the manner described, is $(P_v + P_c)$, an error would occur in the calculated value of apparent viscosity, the corresponding correct pressure being, of course, P_c. In other words, the apparent viscosity would not be measured solely in terms of the capillary, but would also depend on the relative dimensions of the capillary and vessel.

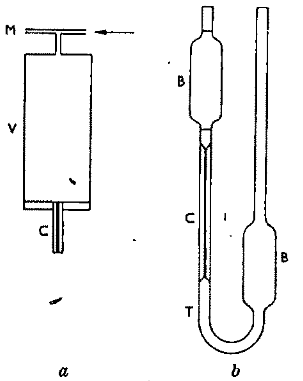
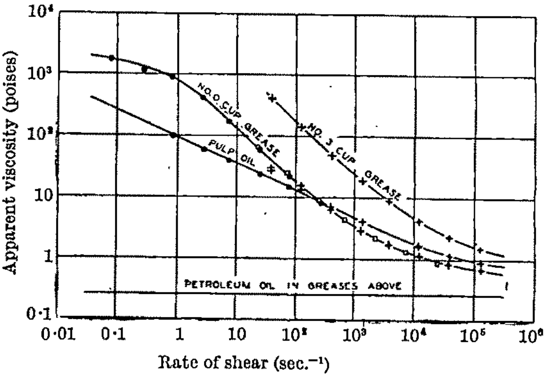


Fig. 1.



		R	L
+,	Capillary No. 1,	$0{\cdot}0238_1$	$3{\cdot}73_5$
□,	,, 2,	$0{\cdot}0417_5$	$3{\cdot}81_5$
●,	,, 3,	$0{\cdot}1871$	$9{\cdot}60_1$

Fig. 2.

The same reasoning can be applied to the Ostwald viscometer, and we find that for materials of the type mentioned, apparent viscosity is obtained not only with reference to the particular capillary, but also to the relative dimensions of the capillary, the two bulbs *BB*, and the connecting tube *T*.

Since most measurements of this kind have been made with types of apparatus similar in principle to those shown, it would appear that this error in pressure measurement might explain many perplexing results published on this subject.

Arveson[7], who measured the viscosity of greases, mentioned this source of error, but did not appear to realize its full significance. However, he eliminated this difficulty in a novel way by recessing the capillary into the vessel, the bottom of which was made a mercury bath to which the manometer was connected. Curves obtained in this way, which show agreement between different capillaries, are given in Fig. 2.

The magnitude of the error involved will depend on the relative dimensions of the apparatus and the form of the viscosity–shear curve of the material. A numerical example, deduced for the Bingham plastometer, will show the order of the error likely to occur. For simplicity let $L/l = 10$ and $R/r = 10$, and assuming an arbitrary rate of shear (taken by Arveson to be $4Q/\pi R^3$, where Q is the quantity flowing per second in a tube of radius R) of 1,000 sec.$^{-1}$ in the capillary, that in the vessel is then 1 sec.$^{-1}$. Taking a representative curve from Fig. 2 (No. 0 cup grease) it follows that $\eta_c = 3$ poises and $\eta_v = 800$ poises and hence $P_v/P_c = 0{\cdot}27$. Thus the apparent viscosity determined in the usual way would be 27 per cent greater than the correct value. This error would be reduced if the rate of shear in the capillary were very high or very low, since for this material the viscosity curve tends to flatten out at the two extremities.

It follows that (unless the material exhibits an extremely rapid drop in viscosity with increasing shear) for a given vessel the smaller the capillary bore and the greater its length, the smaller will be the apparent viscosity. This anomalous variation with radius (and length) is precisely that found by many investigators, and it is usually referred to as the 'sigma' phenomenon. Various explanations have been offered to account for this effect[2], all of which attribute it to a property of the material. Thus Ambrose and Loomis[6] suggest that it is due to thixotropy, while Dix and Scott Blair[8] claim to account for it by assuming that the streamlining layers are not infinitely thin. Other authors attribute the effect to slip at the tube wall.

It is not suggested that the 'sigma' phenomenon is wholly due to this error inherent in the viscometer, but it seems likely that in many instances both effects are present simultaneously. It is possible that in some cases apparently anomalous results can be completely accounted for by the error described, but it must again be stressed that this error can only occur with materials which show a fall in apparent viscosity with increasing shear.

This instrumental error has been eliminated in measurements made recently[9] on rubber solutions and soap-thickened mineral oils using a simplified form of Arveson's viscometer. The results show that for these materials, *provided the capillary is sufficiently long*, thus reducing the 'equilibrium length' to a negligible fraction of the whole, the viscosity – shear curve is independent of capillary size.

A. C. MERRINGTON.

Horsham,
Sussex.
June 28.

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[1] For detailed bibliography, see Scott Blair, G. W., *J. Sci. Inst.*, **17**, 7, 169 (1940).

[2] Scott Blair, G. W., "An Introduction to Industrial Rheology" (London: Churchill Ltd., 1938).

[3] Bulkley, R., and Bitner, F. G., *J. Rheol.*, **1**, 269 (1930).

[4] Weiler, *Ind. Eng. Chem.*, **14**, 634 (1942).

[5] Peek and Ericson, *J. Rheol.*, **2**, 351 (1931).

[6] Ambrose and Loomis, *Physics*, **4**, 265 (1934).

[7] Arveson, M. H., *Ind. Eng. Chem.*, **24**, 71 (1932).

[8] Dix, F. J., and Scott Blair, G. W., *J. Appl. Phys.*, **11**, 9, 574 (1940).

Unpublished.

Alloys of Gold with Alkali Metals

IT has previously been suggested that gold alone among the heavy metals of the first column of the periodic system forms alloys with alkali metals of definite and simple stoichiometric ratio. Matthewson[1] derived from his experiments a formula $NaAu_2$; Zintl[2] mentioned the formation of NaAu. The discrepancy between these results is probably due to the fact that in the work of both authors oxidation or other unwanted reactions of the alkali metal were not excluded.

For the investigation of alloys of alkali metals with antimony and bismuth[3], I used a simple method to determine the composition of such alloys, which had the advantage that the alloy was formed in high vacuum, thus avoiding contamination of the alkali metal. The procedure, which has been described in detail elsewhere[4], was as follows. A known quantity of the heavy metal was evaporated on to the wall of an evacuated glass vessel. Then the alkali metal was distilled on to this metal layer until, even at the highest temperature compatible with the vapour pressure of the alkali metal, no more metal was absorbed. Finally the amount of alkali metal consumed was determined.

Using this method, I have now investigated copper, silver and gold in combination with sodium, potassium, rubidium and cæsium. The experiments confirmed that no definite reaction takes place with copper or silver. They further showed that the gold layer at first quickly absorbs the alkali metal, but during continued distillation the alkali metal is suddenly deposited as a distinct separate layer on top of the alloy layer. Determination of the amount of alkali metal used to 'saturate' the gold layer indicated that all the alloys correspond to the formula Au*M*, where *M* denotes the alkali metal. The accuracy of the experiments was only of the order ± 20 per cent. owing to the difficulty of measuring small quantities of alkali metal, but this accuracy is sufficient to exclude all simple formulæ other than Au*M*. To disprove the rather improbable possibility of a complicated formula, the experiments would have to be repeated with larger quantities of the metals; this would require larger vessels to avoid excessive thickness of the layers.

As was to be expected, the alloys of the Au*M* type are photo-electrically sensitive, but the sensitivity is too low to be of practical importance. An interesting optical property of the alloys is that, like the $SbCs_3$ alloy[3,4], they show no metallic lustre, and their absorption of visible light, in particular near the red end of the spectrum, decreases from sodium to cæsium. The visual change from a practically opaque gold layer to the extremely transparent AuCs layer is particularly striking.

A. SOMMER.

Cinema Television, Ltd.,
London, S.E.26. July 13.

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[1] Matthewson, *Int. Z. Metallograph*, **1**, 81 (1911).

[2] Zintl, *Z. phys. Chem.*, A, **154**, 1 (1931).

[3] Sommer, NATURE, **148**, 468 (1941).

[4] Sommer, *Proc. Phys. Soc.*, **55**, 145 (1943).

Urease Activity and Ascorbic Acid

WITH reference to Mr. Elson's observation[1] that ascorbic acid at low concentrations inhibits urease activity, and that this inhibition disappears in the presence of cysteine, it is worth noting that certain polyhydric phenols, for example, catechol and quinol, also exert at low concentrations (one part in two millions) highly inhibitory effects on urease activity, this inhibition disappearing in presence of thiol compounds such as cysteine[2]. It has been shown that the inhibition in this case is due, not to the phenol, but to the corresponding oxidized product, that is, the quinone present in solution with the phenol. The alleviating action of cysteine is due to the reduction of the quinone to the inert phenol. It may be suggested that, in an analogous manner, the toxicity of ascorbic acid in dilute solution is due to the oxidized form of ascorbic acid, namely, the diketone, present in solution, and not to the ascorbic acid itself. The effect of cysteine will be to reduce the dehydro-ascorbic acid to the inert ascorbic acid, a phenomenon which is known to take place, as shown by Crook[3].

J. H. QUASTEL.

Agricultural Research Council Unit of
Soil Enzyme Chemistry,
Rothamsted Experimental Station,
Harpenden.
July 23.

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[1] Elson, L. H., NATURE, **152**, 49 (1943).

[2] Quastel, J. H., *Biochem. J.*, **27**, 1116 (1933).

[3] Crook, E. M., *Biochem. J.*, **35**, 226 (1941).

Manganese Deficiency in Oats

The value of the water culture method for the study of the role of particular chemical elements in the nutrition of higher plants is generally recognized, and the more exactly the chemical constitution of the culture solution is controlled the more effectively can the study of trace elements be undertaken. By using the water culture technique of Stout and Arnon[1], I have produced the typical symptoms of grey speck disease in oats attributed to manganese deficiency only four weeks after sowing, as well as evidence that this technique will prove valuable in studying the physiological importance of other elements. The method, not previously used by workers in Great Britain, so far as I am aware, involves the use of: 1, 'Pyrex' or 'Hysil' glassware; 2, re-distilled water[2]; 3, specially purified solutions[1]; and 4, the diphenylthiocarbazone colorimetric test[3] for metal impurities in water and nutrient solutions.

In my experiments the culture solutions were prepared according to Arnon[4]. The major nutrient elements (potassium, phosphorus, nitrogen, calcium, magnesium) were added to all cultures. The micro-elements were used in two groups: (1) *A*3 containing copper, boron, zinc, and (2) *B*7 containing aluminium, molybdenum, titanium, vanadium, tungsten, nickel and cobalt. The experiment was designed to show the effect of the *A*3 and *B*7 groups of trace elements alone and together in the presence and absence of manganese. Iron as ferric tartrate was added to all the cultures every week.

The oat grains were germinated over water at laboratory temperature and a week later the seedlings were transferred to the culture solutions in an unheated greenhouse. Fourteen days after this transference, the first signs of manganese deficiency appeared in one of the plants receiving only the *A*3 trace elements. This plant had three leaves and a slightly yellowish-green appearance, and about halfway along the third leaf a grey-green spot had appeared, at which point the leaf had bent over sharply. Seven days later, twenty-one days after planting, ten out of fourteen plants (three of which had died) growing in manganese-deficient culture solutions were showing the typical break on the third and/or fourth leaves at oval grey-green spots. These grey specks soon dried up and became yellow-brown. These symptoms appeared on plants in the culture solutions containing, as regards micro-elements: (1) the *A*3 group only, (2) the *B*7 group only, and (3) the *B*7 and the *A*3 groups. No typical grey speck symptoms as described above appeared in the fourteen plants grown in the presence of manganese.

The effect of the other trace elements was seen to be similar in the cultures with and without manganese. The best plants as regards growth and greenness, in the series without manganese, were those receiving the *B*7 and the *A*3 groups, the next best were those receiving the *B*7 group alone, while the worst were those with the *A*3 group only. The series with manganese showed the same general effect but were in all cases better plants. These observations were substantiated by determining the dry weights per plant in each kind of culture, as shown in the accompanying table.

The conclusion to be drawn is that one or more elements of the *B*7 group are probably essential for the growth of oats in addition to the four generally recognized trace elements manganese, zinc, boron and copper.

Micro-elements added	Average dry weight in gm. of oat plants four weeks old	
	With Mn	Without Mn
*A*3	0·101	0·095
*B*7	0·161	0·130
*A*3 + *B*7	0·238	0·127

This finding for oats is similar to that previousl indicated by Arnon in regard to the elements necessary for lettuce and asparagus.

E. S. Twyman.

Botanical Department,
University of Birmingham.
July 15.

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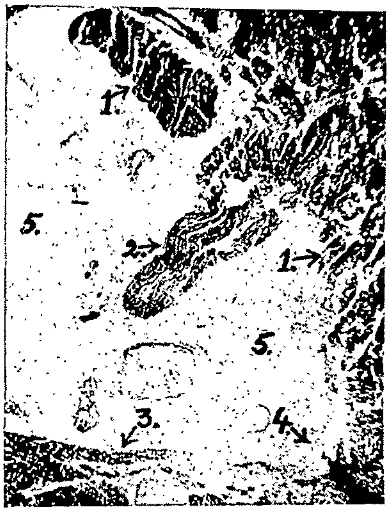
[1] Stout and Arnon, *Amer. J. Bot.*, 26, 144 (1939).
[2] Wilson and Strickler, *J. Ind. Eng. Chem.*, Anal. Ed., 11, 630 (1939).
[3] Hibbard, *J. Ind. Eng. Chem.*, Anal. Ed., 9 (1937).
[4] Arnon, *Amer. J. Bot.*, 25, 322 (1938).

Etiology of Paroxysmal Tachycardia

At autopsy in a case of paroxysmal tachycardia a muscle bundle was found connecting the lef auricle with the left ventricle. In between attacks this case showed an electrocardiogram with shortene *PQ* interval and a slowly rising initial part of th *QRS* complex. This bundle may have been the caus of the disease[1]. The bundle, being more than half centimetre long in its free portion, was visible to th naked eye in microscope preparations. This structur is entirely different from the structures at the *A* border, described by Kent at the end of the las century.



1, left auricle; 2, part of the bundle; 3, left ventricle; 4, annulus fibrosus; 5, fat tissue.

Of further interest is the fact that one sister an three brothers of the deceased also suffered fro paroxysmal tachycardia. One of the brothers di closed a similar electrocardiogram; he had a typic Wolff-Parkinson-White syndrome.

Richard F. Öhnell.

Stockholm.
April 5.

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[1] Öhnell, *Cardiologia* (1940–43),

The Pattern of Youth: an Interim Report

This report, which is really part of a general survey covering dentition, dietary and physical traits in the public schools, deals with provisional conclusions on the effects of war-time rationing on the relative stature and weight of more than 3,400 boys and girls attending the public schools in England and Wales, Northern Ireland and Eire—this last being added as a control since rationing has not been as stringent there as in the United Kingdom.

If it is agreed that superior physique, immunity from disease, courage, ambition, local and national tradition, home influence and energy are the qualities required for success in life, then nowhere can they be found more equitably adjusted than among the economic classes whose children attend the great public schools.

A study devoted to them is one of the principal means of assessing the improvement or physical deterioration of the race.

The conclusions arrived at may be broadly stated as follow: (*a*) that war conditions have had, up to December 1942, no deleterious effect on the stature and weight of the youths in the public schools; (*b*) that they have on the contrary increased the physique of youth in the countries under survey; (*c*) that English boys in the age-groups of 13, 14, 17 and 18 exceed in height and weight the corresponding ones in Eire. The age-group 15 in England are of the same height but weighs more than the corresponding group in neutral Eire; however, the 16-year-olds in Eire are taller but weigh less than their age-group in England. Northern Irish boys in all the age-groups but one, namely, 14, weigh more than their fellows in Eire. The 14- and 18-year-olds are taller than, and the 17-year-olds are as tall as, their corresponding age-groups in Eire; (*d*) with regard to girls the results are not so conclusive, but from the age of 14–18 Eireann girls tend to weigh more than their age-groups in England, Wales and Northern Ireland.

In every instance all the boys and girls in the countries under survey have exceeded the normal height and weight for their ages as given by Quételet or that given for Anglo-Saxons by Dr. Bruce Williamson.

The accompanying tables show the average increase per age-group, as contrasted with the pre-war normal for the English-speaking nations (p. 279 of B. Williamson's "Handbook on Diseases of Children, 1936").

I wish to express my thanks to the principals, headmasters and headmistresses of the following schools in England: Rugby, Repton, King's College (Taunton), The Abbey School (Malvern), Ch. Edward Brooke's (London), Chelsea Polytechnic, Liverpool Training-College, Felixstowe College, Bishop Blackall's (Exeter), Notre Dame Collegiate (Liverpool). In Wales, Howell's School (Denbigh), Howell's (Llandaff and Cardiff). In Northern Ireland, Londonderry High School, Collegiate School for Girls (Enniskillen), Technical High School of the College of Technology (Belfast), Coleraine Academical Institution. In Eire, St. Columba's College (Rathfarnham, near Dublin), High School (Sligo), Celbridge Collegiate School (Co. Kildare).

I also wish to thank Miss Spafford, of the Ling Physical Education Association. Without the active and wholehearted co-operation of them all in these days of depleted staffs, this work would have been impossible.

R. E. G. Armattoe.

7 Northland Road,
Londonderry.
March 26.

Boys	English		Eireann		Northern Irish	
Age Years	Height in.	Weight lb.	Height in.	Weight lb.	Height in.	Weight lb.
13	7·8	14·2	3·8	6·2	1·8	7·1
14	3·1	14·1	2·1	7·1	3·1	2·1
15	3·7	16·9	3·7	10·9	2·7	16·9
16	3·0	10·0	8·0	8·8	3·0	9·0

Girls	English		Eireann		N. Irish		Welsh	
Age Years	Ht. in.	Wt. lb.	Ht. in.	Wt. lb.	Ht. in.	Wt. lb.	Ht. in.	Wt. lb.
9	3·6	11·9	—	—	—	—	—	—
10	2·7	11·6	5·7	11·6	—	—	3·7	7·6
11	3·6	14·2	3·6	8·8	—	—	6·6	16·2
12	4·1	15·7	2·1	3·7	4·1	4·7	2·1	13·7
13	2·8	14·3	1·8	9·3	3·8	9·3	1·8	12·3
14	2·1	11·6	3·1	19·6	2·1	7·6	2·1	14·6
15	0·9	11·9	0·9	21·9	1·9	5·9	3·9	5·9
16	1·4	9·0	0·4	22·0	1·4	3·0	1·4	5·0

Of the 3,400, 1,556 are girls.

Overlapping Abstract Services

In the article "Co-operation in Scientific Research in the British Empire" in Nature of July 10, reference was made on p. 30 to the inquiry which has recently been addressed to members of the Society of Dyers and Colourists, in connexion with the abstracts which appear in the Society's journal. This inquiry was prompted not because of any doubts as to the value of the Society's abstracts service, but by heavy demands on the Society's available space for original matter, and a desire to ensure that the Society's limited supplies of paper during the War were being used to the best advantage.

Of the replies received from members, so many stressed the vital importance to them of the Society's abstracts, which are more detailed, if less comprehensive in their scope, than those available otherwise, that it has been decided it is imperative that they be retained.

A number of our members are in favour of a centralized abstract service; and there is no doubt that the Society would be very glad to discuss this matter with other interested bodies.

James S. Ridsdale.
(Honorary Secretary.)

Society of Dyers and Colourists,
32–34 Piccadilly,
Bradford.

Research and Planning

In the leading article in Nature of August 7 reference is made to my paper "The Autonomy of Science"[1], and the comment is made: "it is, to say the least, unfortunate that he should impute to the type of planning and organization of scientific effort and resources urged by Sir Stafford Cripps an attempt to interfere with the internal discipline of science and the decisions leading to discovery". My paper was printed before Sir Stafford Cripps made his statement of policy. It contains no criticism—much less a rejection—of such policies, which follow the lines established throughout the world, including Great Britain, for at least a generation. Sir Stafford's plans seem in fact entirely admirable to me.

What I criticized were the views concerning the nature of science and the place of science in society which were recently advocated once more by some of the more influential speakers at the January meeting of the Association of Scientific Workers. "Then research will not be conducted for itself, as an end in itself"—was stated in an authoritative summary of the aims set by that meeting[2].

I am not concerned primarily with the future effect of these principles in Great Britain, the great civic tradition of which may protect her indefinitely from their ill effects. Nor would I wish to intervene in this respect. What I am concerned with are these principles themselves, and the prospect of seeing them spread on the wings of Allied victory all over a dislocated world, helping to destroy even further the ideal—which I hold to be essential to our civilization—of scientific truth pursued and upheld for its own sake.

University,
Manchester.

M. Polanyi.

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[1] *Mem. Proc. Manchester Lit. and Phil. Soc.*, 85, 19–38.

[2] "Planning of Science" Association of Scientific Workers, p. 110 (London, 1943).

Future of Technical Colleges

Messrs. Barrer and Andrews have referred[1] to the very important question of the training of students in technical colleges for external degrees, which is raised in the Institute of Physics Report on "The Education and Training of Physicists". Their interpretation of this Report as hoping to relieve the technical colleges of the necessity of preparing students for external university degrees is not perhaps quite fair to the carefully considered wording of the Report. The Report does not deny, or imply, the right of the technical college to give the highest training to the young technologist or to transfer the higher flights of technology to the universities. The actual wording of the Report reads: "It is desirable that the distinction between the functions of the Universities on the one hand and of the Technical Colleges on the other should be clearly recognized and that the Technical College should not be deflected too much from its own important field by the necessity of training students for External University Degrees", and concludes that the training for such degrees should not be a primary function of a technical college.

I am sure that no educationist will disagree with Messrs. Barrer and Andrews in their view that Great Britain requires a number of technological institutes capable of carrying out technical studies to the highest grades, including the creative work of research departments and, it may be added, 'cultural' studies and recreational activities as well. It is not right, however, that the coaching of a relatively few people for examinations run by an outside body, which body dictates a syllabus and a standard with little or no regard to methods of training and opportunities for social development of the individual students, should come to be regarded as the highest function of a technical college and should unduly influence its educational aim.

A planning committee such as that of the Institute of Physics is working in the realm of *educational ideals*, and it is therefore appropriate that it should review the existing provision of university courses in the sciences in order to determine what arrangements may be made so that all those capable of benefiting from a university course may be provided with full facilities for a proper university education. Degree courses in technical colleges are makeshift courses, and have grown out of a makeshift system designed for a period when (1) few universities existed in Great Britain, and (2) the cost of university courses was almost prohibitive for the average individual. While acknowledging their value in the past, and admitting their possibilities to a limited extent in the field of adult education, we may well doubt whether external degrees are adapted to form a serious factor in modern technical education.

Many technologists would prefer to see the larger technical colleges capable of carrying out education and training to the highest standard based on technical subjects, and awarding their own diploma, which should be comparable with a university degree. The courses in such colleges would be complementary to those of the universities, and some university graduates would by arrangement proceed to such colleges for their post-graduate technical training after having completed their degree courses at the university. Then again, within the technical colleges, at a lower level, the National and Higher National Certificate schemes are capable of further development (even on present lines) and should be extended to cover the newer industries, for example, plastics, radio and production engineering, etc. Indeed, there seems no limit to what the technical colleges might achieve in their own particular sphere without duplicating courses which can in general be done much better in the universities.

I feel that the technical colleges are in grave danger of losing their way. At one end of the scale they are flirting with what is essentially secondary school work, at the other with university education, while tending to neglect their most important work, which lies between and covers both full-time and part-time courses up to the highest level of achievement, of a character most in accordance with the needs of the 'real' world, together with the vast field of adult education, cultural, social and spiritual values not being neglected on the way—the whole constituting a 'people's university' in the fullest sense of the term.

Never before has the technical college been such a centre of popular interest in Great Britain as it is to-day—thanks to the opportunities it has had of serving national war-time needs. We who are engaged in this work have surely no longer any need to preach the importance of technical education as had our predecessors, Huxley, Roscoe, Thompson, etc. We failed to take advantage of two previous opportunities to put technical education on a proper footing, namely, in 1889 and 1902. Let us, therefore, not cast away our new opportunities which are on the rising tide, by yielding to the specious attractions of external degrees. We have all to gain and nothing to lose by leaving the universities to do their own particular work (even if it does include what we have come to regard as technological subjects). The technical colleges will best serve the community by developing their special field, which is determined by industry, commerce and the professions, without the restraint of external degree examinations. Nevertheless, it is not desirable that the technical colleges should pursue an isolationist policy, but rather that they should work in co-ordination with the universities, for only in this way can the activities of each be best directed to the establishment of the ideal educational world.

H. Lowery.
(Principal.)

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[1] Nature, 152, 80 (1943).

RESEARCH ITEMS

rigins of Kingsholm, Gloucester

THE movements in Britain of the Second Legion f the Roman forces before it settled at Caer-on have given rise to much speculation. It is ow suggested (Glevum and the Second Legion, art I. By Charles Green. Public Museums, loucester, Occas. Pap., No. 5) that the Legion was stablished at Kingsholm, to-day a suburb lying to he north of the centre of Gloucester, and that later true *Colonia* was founded there to accommodate etired soldiers of the Legion after it had moved to ts permanent home at Caerleon. Furthermore, down y the River Severn, a small quayside settlement rew up which later tended to spread inland from he river. This was the port. It is suggested that n analysis of previous coin and pottery finds, so ar as exact locations can to-day be assigned to them, nd a study of some recent discoveries point to this onclusion. The fact, too, that Ermin Street takes sharp bend at Wotton to arrive at modern Glouces-er, but if continued in a straight line would pass hrough Kingsholm, reinforces the suggestion.

taphylinidæ of the West Indies

THE United States National Museum Bulletin 182 1943) is devoted to a bulky monograph on the above ubject. In the compass of 658 pages the author, ichard E. Blackwelder, has dealt with some 91 enera of these beetles and 468 separate species—xclusive of those included in the subfamily of the leocharinæ. Altogether 6 genera and 212 species re being described as being new. The Aleocharinæ ere omitted for various reasons and chiefly on ccount of the difficulty of recognizing species from nadequate descriptions. It is interesting to note that mong all the species of Staphylinidæ that occur in he West Indies, Cuba has 172 species, Jamaica 128 nd Trinidad 122—more or less proportionate to the ize of those islands. While many more species prob-bly await discovery, this work must be considered as olerably exhaustive for the time being. It was ased on 45,000–50,000 collected specimens: in ddition to these, many others were examined in ublic and private collections. The author specially nentions the co-operation of the British Museum Natural History) in the work of identification. The eys provided are original: there is a full synonymy f all names and detailed specific descriptions are iven, but there is a general lack of illustrations, there eing only three figures in this bulky work. The uthor states that several factors have prevented the se of primary genitalic characters in the descriptions. The first was lack of time to develop the requisite echnique. Another was that some genera do not resent usable specific characters on the genitalia. t is, however, to be regretted that so little has been done on this phase of study for the Staphylinidæ nd many other families of Coleoptera.

ungi from Decaying Alder Leaves

AN interesting and detailed account by C. T. ngold of sixteen unusual fungi growing upon decay-ng alder leaves in a Leicestershire stream has recently ppeared (*Trans. Brit. Mycol. Soc.*, 25, 339; Dec. 942). All the fungi belong to the Hyphomycetes, nd ten are new species within the new genera Margaritispora, Articulospora, Tetrachætum, Tricladium, Alatospora, Lunulospora and Flagellospora. Two new species of the current genus Heliscus have also been found. Structural and taxonomic descriptions of all species are given in detail. The majority of these fungi produce conidia which are branched or have three-dimensional curvature. It is suggested that this structural feature has a survival value in that such spores, borne by the water current after liberation, can readily be entangled by alder leaves submerged in the stream. All except three species have been grown in pure culture on malt agar and oatmeal agar. This somewhat abstruse study nevertheless widens our mycological horizons, and raises important questions of economic ecology connected with the breakdown of organic matter.

Interlocking of Bivalents

S. G. Smith and E. R. Boothroyd (*Canad. J. Res.*, 20, 358; 1943) have made an analysis of the interlocking of bivalents in *Trillium erectum*. In 346 cases of interlocking, there were equal numbers of true and false interlocks, the latter being constituted by one bivalent being inserted between two chiasmata of another bivalent. An interlocked chiasma and chromatid interlocking were observed. The frequency of interlocking is proportional to the length of chromosome arm minus a minimum length. Interlocking reduces the chiasma frequency and would appear to do so by interference with the position at which chiasmata would usually form. The results are discussed in relation to several theories of chromosome behaviour.

Bar-eye Locus in Drosophila

A FURTHER step in the analysis of the position effect at the bar-eye locus in *D. melanogaster* is provided by the discovery of a lethal gene *Eb* by G. Bonnier, M. Nordenskköld and G. Bägman (*Hereditas*, 29, 113; 1943). *Eb* has similar effects to *B* in respect of the expression of position effect upon eye shape. It is situated to the right of *B* and reduces crossing-over in the *X*-chromosome between *B* and *fu*. Cytological studies indicate that the bar segment is not duplicated in *Eb*, but this might be a deficiency. This is, however, unlikely, since a bar/bar-deficiency female has almost normal eyes. The authors therefore suggest that *Eb* is a modifier of *B* within the bar segment and therefore they raise again the question of step allelomorphism and the divisibility of the gene.

Polyploidy and Plant Geography

A. and D. LÖVE (*Hereditas*, 29, 145; 1943) have made a statistical analysis of the frequencies of polyploids in different localities of Europe and Africa. They confirm the view that there is a correlation between polyploidy and latitude. Polyploidy is more common among monocotyledons than dicotyledons. In the Alpine regions of the Pamir, Altai and the Caucasus, the greater hardiness of polyploids is apparent. The preponderance of species in tropical and moderate climates and the low number of species in cold regions is believed to result from the greater adaptability of polyploids to extremes and the greater long-day photoperiodism of polyploids.

Pollen Tetrads in Petunia

H. LEVAN (*Hereditas*, 28, 429; 1942) has discovered a race of *Petunia nyctaginiflora* in which the pollen remains in tetrads after dehiscence. The phenomenon is due to a single recessive gene *t*. Such behaviour may be of value in the analysis of segregation as in fungi and mosses.

Intersexuality in Melandrium

D. Löve (*Hereditas*, 28, 497; 1942) has shown that the *Y*-chromosome of her intersexual plants of *Melandrium rubrum* is different from that of normal male individuals. The *Y*-chromosome of the male is about 7·5 long with a median centromere whereas that of the intersexes is 3·5 + 4·5. The evidence suggests that the "*Y*" chromosome of the intersexes is composed of a normal *X*-chromosome to which a portion of a *Y*-chromosome has become attached. Thus an *XX*-individual with a portion of the strong male determining *Y*-chromosome would probably be such an intersex.

Theory of Chromatography

In chromatography a solution is run through a column packed with a suitable adsorbing material and the solutes deposit on the surface of the material in bands. If afterwards a pure solvent is run through the column the bands move at different rates. The method has found wide applications. D. de Vault (*J. Amer. Chem. Soc.*, 65, 532; 1943) has extended a theory of the process due to J. N. Wilson (1940), which neglected diffusion and non-attainment of equilibrium. Some important results not discussed by Wilson are pointed out. The theory predicts both sharp and diffuse boundaries to the bands formed in the column. Differential equations are set up for multiple solutes, but no general solution is reached. Some evidence is found that here also the boundaries may usually tend to be sharp in front and diffuse in the rear, but the conclusion is not definite. In a typical two-solute case the concentration of the faster-moving solute in the band where it is pure tends to be larger than in the original solution. Some suggestions for further development are made.

Colour of Ferrocyanide Crystals

The colour of alkali ferrocyanide crystals sometimes varies from light yellow to amber. A suggestion that this is due to isomerism has been shown to be incorrect. Another suggestion is that salts such as $K_3[Fe(CN)_5H_2O]$ are the cause of the colour. H. E. Williams (*J. Chem. Soc.*, 223; 1943) has shown that this is not the case with commercial sodium and potassium ferrocyanides, and that the amber-coloured crystals sometimes found in commercial ferrocyanide are caused by the presence of traces of colloidal ferric hydroxide. Methods for detecting and estimating small amounts of the aquo-salt and ferricyanide in ferrocyanide solutions are described.

Busbar Protection

A critical review of the methods and practice of busbar protection is given in a paper read in London recently before the Institution of Electrical Engineers by M. Kaufmann and W. Szwander. The general conclusions drawn from the study are as follows. The high standard of reliability now required of distribution systems greatly enhances the importance of the busbars and demands a correspondingly high standard of performance and reliability in the busbar protective arrangements. Busbar protective schemes are available which attain this standard and can be relied upon not to impair the reliability of any system to which they are applied. The stringent precautions taken to ensure the greatest possible reliability are not an indication that the schemes are not sufficiently reliable in themselves, but are the result of the need for an exceptionally high degree of reliability compared with that of the protection for other elements. Since the selectivity of busbar protection, together with its high speed of operation, constitute its main advantages, it is especially applicable to installations with sectionalized busbars. The application of separate busbar protection lends itself more easily to newly projected plants than to existing installations. It is thus important to give consideration to the possible future application of an appropriate busbar protective scheme in designing new plants. The provision for its future addition should include, for example, insulating the switchgear framework from earth, providing current transformers on both sides of busbar-coupler and busbar-section breakers, etc. Busbar protective schemes must be adapted to the individual needs of the particular case. For the less important installations only relatively simple schemes can be justified economically, but, in general, schemes without some form of 'check' should not be used. Testing facilities should preferably be provided if the scheme is at all elaborate. Though improvements in the existing back-up protection are not a substitute for proper busbar protection, they should be considered in cases where the application of busbar protection is so difficult as to be impracticable.

Photographic Survey of Galactic Clusters

George Alter has discussed the results of a photographic survey of galactic clusters—N.G.C. 6596, 6603, 6605, 6613, 6618, 6645, 6647, I.C. 4725, Tr. 33, Cr. 371, 469, carried out at the Norman Lockyer Observatory, Sidmouth (*Mon. Not. Roy. Astro. Soc.*, 103, 1; 1943). The methods employed have been described in three previous papers. The group of clusters investigated lies within a region which includes most of the small Sagittarius Cloud, and of the eleven star groups which various catalogues record as clusters, it is considered that five are not true clusters. Unfortunately, there is very little convention with regard to including a condensation as a galactic cluster, but in the present case those condensations which have no appreciable concentration and boundary are not considered as galactic clusters and are treated differently from the other six. These other more definitely recognizable clusters presented certain difficulties. The colour index agreed well with the spectral types of their members, but this seemed inconsistent with the fact that these clusters lie within a region where selective absorption has been found, and so some colour excess might be expected. For this reason it must be assumed that the clusters lie in regions where there is little or no absorbing matter, or alternatively, there was a systematic error in the colour index of the investigation. The second assumption seemed much more likely, and it was decided that a systematic error was caused by a wrong photographic coefficient. This error had very little effect on the investigations of clusters which had been previously published, because the zenith distances were small, but in the present cases where the zenith distances are about 70° it is significant. It is suggested that N.G.C. and Tr. 33 contain giants, and a remarkable secondary condensation of ten stars is found in the first of these.

EDUCATION AFTER THE WAR

SOME seventy delegates from twelve different countries attended the fourth general meeting of the Association of University Professors and Lecturers of the Allied Countries in Great Britain, held at New College, Oxford, during July 16–19, which included a conference of the Association of University Teachers. This was the largest and most important educational conference of the Allied Nations yet held in Great Britain, and the delegates were engaged in working out practical methods of post-war education in the occupied countries and seeking collaboration in this sphere with British and international bodies. The conference was welcomed by Sir Richard Livingstone.

At the opening session, at which Dr. S. A. Glaser (president) was in the chair, an address on the history of the University of Oxford was given by Prof. F. M. Powicke, regius professor of modern history at Oxford. Prof. Powicke said that Oxford has never ceased to be a place of debate and controversy. Oxford men have been the pioneers in constructive work for the betterment of the lot of mankind and for the furtherance of a wise imperialism and an international outlook upon affairs. Oxford has always been receptive, and in that it is characteristic of Britain. Now Oxford has to help bind up the wounds of learning but, whatever changes may come, Oxford will insist on being the same. Dr. Glaser remarked that when victory is won, Oxford traditions will inspire and animate university life all over Europe.

On July 17 the conference divided into various sections to discuss such subjects as collaboration with British scholars and with international bodies, reconstruction of science and learning in the occupied countries, post-war education of youth and future collaboration between the universities of Allied Countries in law, science, technology, economy, modern humanities, history, medicine and information for students.

Sir William Beveridge, master of University College, and Lady Beveridge, who have just returned from a visit to the United States, received the members of the conference at University College on July 17, when they gave a brief impression of their visit to America. Sir William said he looks forward to the days when meetings of professors from many countries would be held in every country instead of one or two centres.

Sir Richard Livingstone, president of Corpus Christi College, extending a welcome to the delegates, said that they were welcoming men and women, eminent each in his own branch of learning, ministers of wisdom, knowledge and truth. “But we welcome omething more—a fortitude, endurance and faith in great adversity less often required of scholars, which has not been required of us. We wish to pay homage o that; we hope we shall not forget the example you have shown us; for the exiled scholars of Europe have enriched the history of scholarship with somehing even greater than learning.” The lack of a ommon language and of a common faith, he said, are great obstacles which should be surmounted. “Many stones need to be set into the foundations if he building of international friendship is not to be swept away by the next big flood that comes. Economic agreements, political understandings, personal friendships and mutual intercourse are among them. But these are not enough by themselves. The only mortar that can hold them together is a common faith. Universities absorb themselves in their various specialisms, and ignore the question of conduct and of the beliefs from which conduct springs, as if these were no part of their business. If so, we are ignoring the centre of the problem and gravely limiting our contribution to its solution. I would plead that we regard it as very much our business, and know that I shall plead to sympathetic ears, for it is not your knowledge or your studies that have inspired and sustained you during four black years—it is a spiritual force, a faith.”

Aims of the Association

Dr. Glaser spoke of friends and colleagues in the occupied countries, and said that those present would wish to confirm most solemnly their unity and solidarity with them and to send to those still alive words of sympathy and belief in their liberation. Speaking of the foundation of the Association, he emphasized the encouragement and help they have received from their British colleagues. The Association comprised 249 members and two guests, and now represents seventeen countries. One of their main tasks, perhaps even the reason and justification of their formation, is the reconstruction and rehabilitation of the university life in the occupied and invaded countries when the War ends. A special section has been formed to deal with the problem and is working in close collaboration with the Committee on Post-War Education of the British Association.

The Association's second aim is contact and collaboration with the Anglo-Saxon scientific world. Prof. Glaser spoke of their collaboration with the British universities and said they have met everywhere great friendliness, understanding and hospitality. He mentioned the idea of an international university, an Allied academy of medicine and an international university institute, which would be considered as a centre of university education, with a special information and registration office and a department for comparative education. “If the only result of our present work and endeavour would be the fact that we came together and succeeded in formulating a common basis for collaboration, this one fact would be a remarkable achievement and of far-reaching consequences.”

Maintenance of European Civilization

Dr. Gilbert Murray said they had a common aim that united them far beyond victory in the War and the restoration of national freedom; there is the immense and inescapable task of maintaining European civilization. “We Europeans are trustees for the human race of a great treasure—a treasure built slowly up by the efforts of the human souls in Greece, Rome and Jerusalem, and in the free nations of modern times. People like you and me must see that it is not lost. War is deadly to a civilization like ours. A Nazi victory would utterly destroy it. You and I can do something for the material side, but the intellectual is our special and obvious duty, and I am sure that no intellectual restoration is worth much which does not carry with it a moral restoration as well.”

The White Paper of the Hot Springs Conference on the organization of the agriculture and food supply of the world and the report on the transition from war to peace economy just published by the

Economic and Financial Organisation of the League of Nations, he added, show that, appalling as the post-war condition of Europe is likely to be, the United Nations have means of dealing with it such as have never been equalled or approached in the world before, and, so far as we can judge, the present leaders of the nations are firmly resolved to use them. He reminded his audience that as university teachers of the Allied Nations, they will have great material difficulties to contend against, but he sees no reason to expect such obstacles as would make it impossible for them to carry out their obvious duty—to keep alive the intellectual and artistic culture of Europe.

Post-War Plans

Prof. A. Sommerfelt, in dealing with the future of the Association, referred to the need for maintaining and extending its aims. He suggested that the Association should become an international organization, and that as enemy-occupied countries are liberated university professors and lecturers of those countries should be invited to join. Prof. Sommerfelt also suggested considering the appointment of a permanent secretary and secretariat, and urged the need for linking up with the international educational organizations which will be set up after the War.

The conference considered reports from the various sections which had been at work on the possibilities of setting up an educational clearing house for Europe. The law section was asked to prepare a list of English law books which would constitute a working law library for universities on the Continent. The history section had discussed the possibilities of preparing a handbook of suggestions for teachers dealing with the problems of objective history, a text-book of world history for secondary schools, and a short history of the war, starting from January 1, 1938. The science section particularly emphasized the need for establishing an international body for the collection and co-ordination of information concerning inventions and discoveries.

Prof. Jean Timmermans, of Belgium, was elected president of the Association for the ensuing year.

International University Conference

The members of the Association of University Professors and Lecturers of Allied Countries took part, on July 19, in a meeting of the International University Conference, held under the auspices of the Association of University Teachers. Dr. Gilbert Murray presided.

Prof. Stefan Glaser, Polish Minister to Belgium and Luxemburg, speaking of the Association of the University Professors and Lecturers of Allied Countries in Great Britain as a permanent post-war organization, said they are now trying to elaborate the final statutes of the Association. The Association will probably be transformed in due course into an International Association of University Professors, in order to give colleagues from neutral countries the opportunity of joining the Association as full members. The definite organization of the Association will be postponed until after the War, when their colleagues from the occupied and invaded countries will be able to express their views on the matter. Until then the Association will be open unconditionally to scholars from Allied countries, and its seat will probably be Great Britain.

The Association will endeavour to protect the professional interests of university teachers, an this will be not only in their individual or persona interests, but also, and perhaps above all, in th interests of science and learning, with the object o assuring the most appropriate conditions and atmosphere. It will also deal with all matters and problem of interest and value to the object and aim of thei endeavours, namely, science and research work.

In his opinion a true intellectual solidarity, spiritual understanding based on mutual confidenc and friendship among scholars, is not only the bes pledge for the progress of culture and civilizatio but also for a political understanding, for a wis community of their countries and their people, an therefore for the security of peace and order in th future.

Prof. R. J. Tabor (Great Britain) introduced proposal, which was agreed to, that the reconstructe International Association should function as a clearing house and an information centre on universit affairs. Another proposal, that it should be a functio of the International Association to safeguard th freedom and professional status and interests o university teachers, introduced by Prof. S. Brodetsk (Great Britain), was carried.

An International Institute

Agreement was also reached on a further proposa that the International Association be invited to tak over the functions of the International Universit Conference. This proposal was introduced by Pro R. C. McLean (Great Britain), formerly secretary o the International University Conference.

Prof. Stefan Glaser introduced a proposal that th International Association should be asked to tak steps towards the creation of an International University Institute. The Institute would serve as a information and registration centre and would dea with such problems as exchange of teachers, exchang of students, research work in foreign countries, programmes of studies, inter-validization of diploma standard text-books and international congresse and conferences. It would also, he suggested, hav a school of comparative education, the aim of whic would be the facilitation of specialization and th provision of experts to the respective universities.

This proposal was also agreed to, and the conference than expressed its general approval of th constitution and aims of the proposed Internationa Association of University Teachers.

An International Language

The conference concluded with comments on som factors which hinder the development of internation relations, and Prof. A. Sommerfelt (Norway), speakin of the language difficulty, said the future internation organization of university teachers ought to dra the consequences of the events they were passin through. It ought to recognize only English an French as its official languages.

Prof. J. Timmermans (Belgium) agreed that th English language would play an important part i the future, but felt that it is essential to go ahea with research work with a view to the creation of a artificial international language. International trad and scientific intercourse require a language which simple as well as precise and invariable. An artifici language is as necessary in that connexion as th notes used for music.

NEEDS OF LOW-INCOME FAMILIES*

A SUB-COMMITTEE of the Aberdeen Branch of the Children's Nutrition Council has made a survey in response to a suggestion of the Director of Education for Aberdeen that local authorities, having the power to provide free meals out of public funds for necessitous school children, would find it very useful if some standard by which to judge 'necessity' in every particular case could be made available. It may be of interest to mention that such a standard was approved by the Board of Education and has been in use for the last three years in Chester. It was designed by the present writer for the Chester Education Committee, and its purpose was to determine appropriate maintenance allowances to be paid in respect of children awarded special places in secondary schools, taking into account the size of the family income. Each case was previously dealt with on its merits, and some gave rise to a good deal of discussion and consequent waste of time. Now, all are settled automatically by reference to an objective scale of income needs. There is no doubt that such scales will in due course be adopted generally throughout Britain. They are obviously more scientific than the prevailing methods of assessment, which mostly take into account only the available income per head and aim at keeping grants below an agreed limit selected on no very rational basis.

Assuming payment of rent and rates or taxes has been made out of income, what is the minimal net balance needed for the adequate maintenance of any given family ? That, in essence, is the question to which those who made the Aberdeen survey sought an answer. It will be noted that it is virtually the same question as that Sir William Beveridge had to consider in framing the allowances, under his Plan for Social Security, to be paid to families in want due to the cessation of earnings or some other cause. It will therefore be of interest to compare his estimated figures with those proposed as a result of the Aberdeen inquiry.

Those who are at work on such problems should always bear in mind also the results of the analysis of a random sample of nearly 9,000 weekly budgets of households, living in industrial areas, collected by the Ministry of Labour in 1937–38. These budgets give authoritative information about the actual expenditure of working-class families, and can be accepted as more widely representative than the figures which result from any purely local inquiry. They provide an invaluable check on estimates of the minimal necessary expenditure of low-income families in a particular area.

The Aberdeen Branch of the Children's Nutrition Council found that the cost of a suitable diet for a moderately active man in August 1942 was 8*s*. 9*d*. a week. This is one of the key figures used in the Aberdeen survey. To translate 'persons' into 'standard' men, each person less than fourteen years of age was given a man value of 0·65, while each person of fourteen years and more was reckoned as one, irrespective of sex. This is a second key figure in the inquiry. Nearly two thirds of the thirty families investigated spent 45–60 per cent of their available income on food (available, that is, after deducting rent and taxes). Accordingly, 55 per cent was taken as the ratio which expenditure on food normally bears to available income in families with small incomes and two or more children to support. This is a third key figure in the inquiry, for it is thence assumed that the basic minimal income per man value per week should be taken as $\frac{100}{55}$ of 8*s*. 9*d*., or 16*s*., for this type of family.

In the Beveridge Report it is stated that it would have been possible, at 1938 prices, "to provide an adequate dietary, either on the scale laid down in the 1936 and 1938 Reports of the Technical Commission on Nutrition by the League of Nations or on the scale laid down in 1933 by the Committee on Nutrition of the British Medical Association, for a man and woman together at a cost of about 13*s*. a week". This, Sir William Beveridge suggested, could reasonably be subdivided : 7*s*. for a man and 6*s*. for a woman. The corresponding average figure for a child, on the League of Nations dietary, he put at 5*s*. 11*d*. Allowing for the change in prices since 1938, the Beveridge food standard becomes about 8*s*. for a man, 6*s*. 10*d*. for a woman and 6*s*. 9*d*. for a child in August 1942 ; whereas the Aberdeen standard at that date is 8*s*. 9*d*. for a man or woman and 5*s*. 9*d*. for a child. When the two standards are applied to a family of husband, wife and three children, the Beveridge standard provides 35*s*. 1*d*. and the Aberdeen standard 34*s*. 9*d*. for the purchase of food. Compensation is thus made for the rather high allowances given in Aberdeen to each parent—when compared with the League of Nations standard as interpreted in the Beveridge Report—by the rather low allowances given to the children.

According to the Ministry of Labour budgets, 46 per cent of the average net expenditure per household (after subtracting the average amount spent on rent and rates) was accounted for by food in 1937–38. But these families included many in good as well as in poor circumstances, so that the 55 per cent taken as the corresponding proportion in Aberdeen for low-income families does not seem unreasonable. For the present purpose the average budget expenditure may also be taken as a rough guide to the minimal cost of household and personal sundries. If, at a guess, one third of the actual average budget expenditure, say, 8*s*. 6*d*., is accepted as a reasonable minimum allowance for a family with three children, and account is taken of the rise in prices by August 1942, we have the following estimate deduced from the average budget family figure : 12*s*. 10*d*., as compared with 13*s*. 6*d*., the Aberdeen allowance. For clothing, and fuel and light, the Aberdeen scale for the same family may be more fittingly compared with the standards used by Sir William Beveridge, although these are really based also on the budget figures. Allowing for price changes, the figures are 9*s*. and 6*s*., respectively (Aberdeen), and 10*s*. 7*d*. and 6*s*. 4*d*. (Beveridge).

Several important points are stressed by the authors in the account they give of this survey. There is no space left to comment upon them here, but the hope may be expressed that the report will be widely studied by representatives of local authorities who are closely concerned with the problems raised, and that they will be encouraged thereby to adopt suitable scales for their own areas. Such scales should, of course, be revised periodically to allow for price changes and, possibly, generally improving standards of living. This is done once a year in Chester.

D. CARADOG JONES.

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* A Budgetary and Dietary Survey of Low-Income Families, Aberdeen, August 1942. By a Sub-Committee of the Aberdeen Branch of the Children's Nutrition Council. Pp. 28. (Aberdeen University Press, 1943.)

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES

ANNUAL CONGRESS

THE South-Eastern Union of Scientific Societies held its forty-eighth annual congress at Reading on July 24, a single day of sessions attended by eighty representatives and members, a number above average for such war-time congresses.

A representative assembly to transact the business of the constituent societies was held in the Abbey School, at which C. E. N. Bromehead of the Geological Survey was elected president of the Union for 1943–44. The new treasurer is Mr. Clifford Musgrave of the Brighton Museums.

"Geology and Health" was the title of Mr. Bromehead's address. His theme centred around the effect upon the nation's health of minute quantities of certain trace-elements which are only now beginning to be understood or even recognized. In particular he described his own work as a geologist together with medical research into cases of endemic fluorine poisoning. Since 1930, work in the United States and India has shown that as little as one or two parts per million of fluorine in drinking water has a serious effect on human teeth during the period of their formation, and Dr. D. C. Wilson, who has done much work on fluorosis in India, in 1939 found that 'mottled teeth' due to this cause are not uncommon in Great Britain. Water supplies are being examined for its contamination in collaboration with Dr. M. M. Murray, a biochemist. Fluorosis may attack all bony structures in adults as well as children and may produce curvature of the spine, arthritis, neuritis or any rheumatic symptoms and, possibly, goitre. At Hook Norton in Oxfordshire cases of fluorosis have been accompanied by cretinism even where deficiency of iodine is not known; its assimilation may be inhibited by fluorine. Another trace-element of importance is molybdenum, which only affects cattle and sheep—not horses and pigs—through eating the pasture in fields where the soil contains appreciable quantities of that element; the cure is doses of copper sulphate administered to the sickening animals. A plea was made for the closer collaboration of geologists and medical research workers in solving many problems of health in which a geological aspect is involved.

At the sectional sessions the following papers were read: "Manorial Pigeon Houses", by E. Yates; "The Future of Fossil Botany", by Prof. T. M. Harris; "The Future of Quaternary Research in Britain", by K. P. Oakley; "The Recent History of the Rivers near Reading", by Prof. H. L. Hawkins; "A Survey of Malvern in Social Science", by Mrs. D. Farquharson; "Seeds and Seed Growing", by A. P. Balfour; "The Edible Crab", by E. A. Robins; "The Striped Hawk-moth in the British Isles, May-June, 1943", by Capt. T. Dannreuther—the latter on behalf of the Insect Immigration Committee to report greater abundance this year than ever known since the records started in 1824, namely, 340 moths seen and 97 captured and another generation expected in the autumn bred here.

Later, visits were paid to the University of Reading, the Municipal Museum, the Abbey ruins, etc.

T. D.

APPOINTMENTS VACANT

Applications are invited for the following appointments on o before the dates mentioned:

Junior Scientific Assistant (male or female) in Agricultural Economics—The Agricultural Officer, University of Bristol, 2 Berkeley Square, Bristol (August 25).

Fieldman (temporary) to the Advisory Entomological Section of the Department of Agriculture—The Registrar, The University Leeds (August 26).

Teacher of Chemistry for Junior work in Technical Day School and Industrial Intermediate B.Sc. class in the Technical College, and a Teacher of Mathematics for Junior work in Technical Day School and Technical and Intermediate B.Sc. Mathematics in the Technical College—The Chief Education Officer, Education Offices, Park Road, West Hartlepool (August 27).

Assistant to the Advisory Chemist (should possess an Honours Degree in Science, with a knowledge of analytical work)—The Advisory Chemist, School of Agriculture, Cambridge (August 28).

Teachers (2) of Engineering Subjects, one of whom should be able to teach some Metallurgy, in the Smethwick Municipal College—The Chief Education Officer, 215 High Street, Smethwick (August 30).

Lecturer in Geology—The Secretary, University of Durham, 38 North Bailey, Durham (August 30).

Lecturer in Mechanical or Production Engineering Subjects up to Higher National Certificate standard in the County Technical College, Wednesbury—The Director (H), County Education Offices, Stafford (August 31).

Lecturers in Mechanical Engineering, qualified to teach Strength of Materials and Metallurgy up to Higher National Certificate standard—The Principal, South-West Essex Technical College and School of Art, Forest Road, Walthamstow, London, E.17 (August 31).

Psychiatrist (full-time or part-time), and a full-time Educational Psychologist, in the Liverpool Child Guidance Clinic—The Town Clerk and Clerk to the Local Education Authority, Town Hall, Liverpool (endorsed 'Child Guidance Clinic') (August 31).

Professor of Animal Husbandry (Hygiene and Dietetics)—The Secretary, Royal (Dick) Veterinary College, Edinburgh (August 31).

Power Station Superintendent—The Engineer and Manager, Brighton Electricity Undertaking, Electric House, Castle Square, Brighton 1 (endorsed 'Power Station Superintendent') (August 31).

Demonstrator of Biology—The Dean, Guy's Hospital Medical School, Sherwood Park, Tunbridge Wells (September 1).

Lecturer in the Department of Dyeing in the Bradford Technical College—The Director of Education, Town Hall, Bradford (September 1).

Lecturer in Mathematics in the Coventry Technical College—The Director of Education, Education Offices, Coventry (September 7).

Laboratory Steward in the School of Pharmacy—The Registrar, University College, Nottingham.

Scientific Editor of Proceedings, Bulletin, Reports and Publications—The Secretary, British Coal Utilisation Research Association, Experimental Station, Rickett Street, London, S.W.6.

Senior Technical Advisers (3), (Reference No. C.1791), and Junior Technical Advisers (2), (Reference No. C.1792), for general work in the Machine Tool Control Section of the Department of Supply of the Government of India—The Ministry of Labour and National Service, Central (Technical and Scientific) Register (quoting the appropriate Reference No.), Alexandra House, Kingsway, London, W.C.2.

Lecturer (temporary) in the Department of Electrical Engineering—The Principal, Borough Polytechnic, Borough Road, London, S.E.1.

Deputy Government Chemist for Jamaica—The Ministry of Labour and National Service, Central (Technical and Scientific) Register (Reference No. O.N.F.1525), Alexandra House, Kingsway, London, W.C.2.

Fuel Efficiency Officer (Technical) for the non-ferrous metals (wrought) industry—The Ministry of Labour and National Service, Central (Technical and Scientific) Register (Reference No. O.N.F. 1526X), Alexandra House, Kingsway, London, W.C.2.

Teachers for Evening Classes in Physics up to Intermediate Science standard—The Director of Education, The Polytechnic, 309 Regent Street, London, W.1.

Geography Mistress for a Girls' Boarding College in Natal—Education Committee, Society for the Oversea Settlement of British Women, 3 Sanctuary Buildings, Great Smith Street, London, S.W.1.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

British Rubber Producers' Research Association. Publication No. 33: The Vapour-Pressure Equations of Solutions and the Osmotic Pressure of Rubber. By A. R. Miller. Pp. 16. Publication No. 34: Characteristics of Wild Rubber. By G. R. Tristram, G. Gee, L. R. G. Treloar and G. A. Jeffrey. Pp. 4. Publication No. 35: Why is Rubber Elastic? By L. R. G. Treloar. Pp. 10. Publication No. 36: Interaction between Rubber and Liquids, 4: Factors governing the Absorption of Oil by Rubber. By G. Gee. Pp. 16. (London: British Rubber Producers' Research Association.) [38

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PLANS FOR RECONSTRUCTION IN GREAT BRITAIN

THE dangers which follow on the Government's delay in announcing its decisions on the Uthwatt and Scott Reports and in laying down the broad lines of its planning policy become almost daily more apparent. The scope and imaginative courage of the plan for the County of London prepared for the London County Council (see p. 227) is one of the strongest of a number of recent challenges to action. The plan itself is still under discussion by the Council, but obviously it cannot be given proper consideration without reference to other planning authorities. At almost every point regional considerations arise; often they predominate, as, for example, in projects affecting the distribution of industry and of the industrial population.

It is not merely that the size and wealth of the London County Council ensure that its proposals must exert an important influence on the plans of the many smaller authorities. The distribution of open spaces, the layout of roads and railways, the shopping centres, markets and theatres may be largely domestic matters. The grand features of the plan—the dispersal of large numbers of population and the controlled location of industry—are matters of regional and national concern, and their determination involves decisions of national policy. Publication of the plan at the present moment has provided an outstanding example of the way in which the absence of authoritative decisions by the Government creates formidable difficulties in the preparation of reconstruction plans by local planning authorities.

No planning for the location of industry, either in the form of the dispersal of industry and population from congested areas or in the form of the direct provision of industrial employment where it is needed, is possible before the Government has made three fundamental decisions: on the Barlow Commission's proposals for the decentralization of industry; on the Scott Committee's qualifying proposals for the control of construction in rural areas; and on those of the Uthwatt Committee regarding the methods of land control by which the direction of industry and construction are to be effected. The development rights scheme dealing with undeveloped land and the proposals for strengthening public powers of acquisition in urban areas may not indeed be sufficient in the great urban problems such as that of London, as the Uthwatt Report itself indicates. There is, however, no indication of official initiative or of any national economic policy in these vital matters. Without such a national policy adequate schemes cannot be prepared, as the London plan itself demonstrates conclusively. Local planning is at a standstill until the national policy is made known. No lip service to reconstruction will clear the Government of something more than a suspicion of deliberate obstruction if this position persists.

A further difficulty exemplified in the London plan is also emphasized in Guy Hunter's "The British

Way in Local Rule",* and in a recent "Occasional Paper" of the National Institute of Economic and Social Research† by Prof. J. R. Hicks and U. K. Hicks. In the latter paper, which gives a further example of the important contribution which the Institute is continuing to offer to social science and reconstruction, Prof. J. R. Hicks and U. K. Hicks present part of the results of an inquiry into the burden of local taxation which they are conducting on behalf of the Institute. Although this investigation of county boroughs in Britain was limited to an attempt to supply answers to two questions of fact, its conclusions as to policy and as to the functions of local government, together with its observations on the Beveridge Report, give it an importance highly relevant in the present connexion regarding the relations between central and local government in planning.

To the two questions of fact the report returns a straight answer. The main reason for disparity in rates is disparity of wealth. A poor town cannot get enough revenue to reach an average standard demanded by public opinion, backed by direct and indirect pressure of the central government, without imposing a crushing poundage. A rich town can reach the same standard without any strain. As regards the recrudescence of the rate problem, the general growth in the nation's economic prosperity during the nineteen-thirties led very naturally to an increase in local expenditure, which in the fields of health and education left a larger share of the increase to be borne by the rates. The decease of the old Poor Law also placed unforeseen responsibilities on the local authorities, but the revolution in the standards of public assistance was by far the most important factor in the renewed pressure on the rates. To preserve the national resilience against future economic shocks by preventing such possibilities before they occur, the authors suggest that the endemic crisis of public assistance could be ended in a way altogether consistent with present aspirations for social security and also profoundly consistent with the natural evolution of English institutions by a National Board of Guardians to deal with domiciliary relief.

Once again, therefore, we are brought face to face with the need for a declaration of general policy in regard to local government reform, and this in a field closely touching that covered by the Beveridge Report. Moreover, Messrs. Hicks make some pertinent observations on local government generally which accentuate the need for decision. Local government needs to be equitable financially, but it should also be an effective organ of democracy, and this it clearly is not as we have it at present. Again, it is no longer necessary as formerly for such matters as relief to be local responsibilities. Messrs. Hicks point out that we are freer than our ancestors to choose what functions should be allotted to local government, and that we should make our choice, not merely on grounds of efficiency in administration but also with a view to the possibility of using local government to give practice in the working of democracy to far wider circles than can be brought into any intimate contact with the national parliamentary organization.

This goes to the roots of the matter, and no passage in this valuable study deserves to be more widely pondered than that in which the authors indicate criteria on which such a choice could be made. In particular, they refer to the opportunity for achievements of a distinctly local character offered by the field of 'civic amenities' in its broadest sense, including not only highways, housing, parks and public lighting, but also town planning and public buildings. Nor is this all. Analysis of the subject from a point of view totally different from that of Sir William Beveridge has led to the same conclusion as to the urgency of transferring public assistance to central control. This paper, however, directs attention to the dangers which would arise if the Beveridge proposals were enacted and no alteration made in the financial relations between the central government and the local authorities. If the Social Security Plan is not to be, in one important respect, a sham, its cost must be distributed fairly, not only between classes but also between localities. Furthermore, apart from the suggestion, to avoid this danger, of a national rate, emphasis is once more laid on the necessity of a proper regional co-ordination of hospital services. The present extremely haphazard development of such services involves grave danger of disproportionate burdens being placed on the poorer authorities.

The same necessity for finding at the centre the ground plans of policy and the solution of legal and financial obstacles is stressed by Guy Hunter in his pamphlet on the "British Way in Local Rule". For many of the proposed reforms of education, transport and public utility services, as in planning, the areas of operation differ widely from the present local government areas. This administrative difficulty must be faced if we are to draw effectively on the local councils for their experience, leadership and goodwill in the execution of policy. The London plan itself both affords evidence of the value of local tradition and experience and challenges the Government to declare its mind and policy. Paralysis, if not chaos, must speedily result if we are left much longer in doubt as to whether a general reform of local government areas and powers is in prospect, or whether it is proposed to tackle planning first, grafting a new pattern of planning authorities on to the existing structure of local government.

The challenge to Government and Parliament to decide and act on the fundamental assumptions on which the London plan rests is as unmistakable as the challenge which the plan offers to the imagination and resource of London's citizens. Fully as emphatically, however, the recent debate in the House of Commons on the Forestry Commission showed the dangers which have attended the failure to plan with foresight, determination and consistency in the period since the War of 1914–18. The recent report of the

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* The British Way in Local Rule. By Guy Hunter. (Oxford Pamphlets on Home Affairs, No. H (8).) (London: Oxford University Press, 1943.) 6d. net.

† Standards of Local Expenditure: A Problem of the Inequality of Incomes. By J. R. Hicks and U. K. Hicks. (National Institute of Economic and Social Research, Occasional Papers, No. 3.) Pp. 61. (London: Cambridge University Press, 1943.) 4s. 6d. net.

Forestry Commission puts the problem of afforestation, agriculture and rural reconstruction in its right perspective but, as the report itself indicates and as Mr. Clement Davies reminded the House of Commons, n spite of a parallel report twenty-five years ago, mmediately the danger was passed, we reverted to our old chaotic methods.

There can be no question that in this particular matter the Government is right in proceeding with caution, and the assurance of financial continuity in the vigorous execution of whatever policy is finally adopted is all that could reasonably be expected at the moment. Afforestation is essentially a problem demanding a long-term policy of assured continuity. It has to be related to agricultural policy—its relation to hill-grazing requirements was repeatedly stressed in the debate, and Sir William Jowitt intimated that the Government is awaiting reports on the hill sheep ndustry—and a long-term policy for agriculture has yet to be formulated. Again, afforestation, like the larger question of agriculture, is linked with the broad question of export and import policy in our post-war trade, and no continuous long-term policy can be determined without full consideration of these questions also.

The report itself received some criticism as well as praise in the debate and, whatever its intrinsic merits, the scheme proposed is confused in aim and gives no clear guidance as to the real objectives of afforestation policy. There was, however, general support for the view that there should be a more effective central administration of forestry, whether or not it was placed under the Minister of Agriculture, and less reliance on, or tenderness towards, private owners than the report itself suggests. Sir William Jowitt assured the House that forestry would be considered along with post-war commitments as a whole, and that pronouncement on policy would not long be delayed.

With that assurance there would be no reason for dissatisfaction, but for the Government's own record in the field of reconstruction policy. It has to be admitted that some of the matters raised in the Forestry Commission's report, as was noted in the debate, touch on the proposals of the Uthwatt Report in regard to the ownership of land. Others affect the policy of rural reconstruction raised by the Scott Report. Once again we come back to the central point at issue, that over the whole intricate field of post-war reconstruction certain broad and basic decisions of policy are required of the Government before policy can be formulated, nationally or locally, in particular fields, and plans prepared for the execution of such policy regionally, locally, or in specialized fields. Appreciation of the complexity of the situation and the general interlocking of the many post-war problems is widespread and tempers what might otherwise be a dangerous impatience with the Government's delay. If, however, that delay continues indefinitely, impatience may pass into a sense of frustration, with disastrous consequences not only to the war effort but also to our chances of establishing the harmonious co-operation of all the many elements in our institutions—local government, central administration, Parliamentary oversight and technical and professional advice, and above all the keen interest of the average citizen in local rule—on which depend our hopes of building a worthy post-war world.

RECLAIMING THE GREAT WREN

County of London Plan

Prepared for the London County Council by J. H. Forshaw and Prof. Patrick Abercrombie. Pp. xii+188+59 plates. (London: Macmillan and Co., Ltd., 1943.) 12*s*. 6*d*. net.

SELDOM in the history of Great Britain can such a gigantic scheme of land reclamation have been put forward as a practicable proposal; seldom can such a case have been made out for powers to alter the physical environment of a great population. The book of the County of London Plan is first and foremost a quite remarkable essay in public relations, in the right kind of publicity for the special aspect of democratic action which we call 'town and country planning'. Published at a price which must be suited to the purchaser rather than the promoter, beautifully set-out and illustrated, and finely printed, with large coloured maps, descriptive photographs, and a host of diagrams and line drawings, the book is the best ambassador to the public that the plan could have. Neither Moscow nor New York were surveyed so ably and in so popular a format, and only Amsterdam can claim to have produced anything comparable to it. It is not possible to read it without becoming deeply interested in the future of London, as in its past; and in a world of war-time restrictions, this achievement of authors, publishers, printers, illustrators and engravers is, in itself, a matter for congratulation.

With such a complex subject, expert presentation is something to be thankful for; the gist of the matter is nevertheless far from easy to analyse. Clearly the main contribution which the plan makes is its imaginative grouping of the residential neighbourhoods and the commercial and administrative centres, of which London is composed. Its most important proposal is therefore one of density, that is to say, the size of the population and its disposition within the county boundaries, the numbers that are being—or should be encouraged to be—moved out. The elements that must contribute to the realization of such a comparatively stabilized pattern, namely, the roads and railways, the location of workplaces and the provision and maintenance of open space, are all secondary to the social reorganization which is the basis of the plan.

Before examining the road or rail proposals, therefore (which are in fact described as tentative, and for the consideration of a "specially-appointed investigating body"), one must consider the essential principles involved in the proposed re-grouping of the population. These principles are in harmony with enlightened thought in the realms of housing, social science and public administration; nevertheless the consequences of their application in any particular case are liable to be intensely controversial. It may mean flats instead of houses, footways instead of traffic approaches, restriction to a local rather than a central shopping area, or a reduction in the time of journeys to work. Briefly, the plan contemplates "the conservation or creation of communities which would be divided into smaller neighbourhood units of between 6,000 and 10,000 persons, related to the elementary school and the area it serves". Parallel with this the plan proposes three standards of density, reasonable for the central, sub-central, and suburban areas to which they would be applied, namely, 200, 136 and 100 persons to the average acre. These standards are then compared with existing densities, the area in each case being composed of the houses, their gardens and yards, the service and access roads, and half the main roads bounding the site. The excess represents the number to be decentralized from each area; and, allowing for variations in the national population trends, the total for the County of London is estimated to be about half a million.

This establishment of a standard of density, and its use as a measuring rod to determine the degree of congestion, is a difficult business. The authors of the London plan have very courageously proposed these compromise figures, as suitable to the particular case of London, capable of being met without the necessity for perpetrating retrograde housing conditions, and in proportion to their expectations of the corresponding decentralization of industry. Many people will view the compromise as an unhappy one; they will take the view that ideal housing conditions —which means in effect a house and garden for at least 90 per cent of all populations, including that of London—should determine the standard of density, and that industry should be compulsorily decentralized to enable this standard to be carried into effect. Such criticism is logical, but scarcely realistic. As it is, the figures proposed are an enormous advance on present conditions. The number to be housed at a density of 200 per acre (which comes down to less than 100 to the acre when open spaces on the scale of 4 acres per 1,000 of the population are included in the calculation) is only the central 300,000; and most of those are now housed at almost double the density. Mr. Forshaw and Prof. Abercrombie consider that reasonable conditions of access, lighting, open space and so forth, would only be obtained by housing people in flats at this density; but Mr. Trystan Edwards has recently written to *The Times* to state that it could be done with two- or three-floored terrace houses. The intermediate density of 136 would normally require two flats to every house (though again Mr. Edwards states that it could be met by bungalows!); and the lower density of 100 would normally have more houses than flats.

In spite of the formidable opposition already raised against the standards proposed in the London plan, it seems likely that they will find general support; unless really drastic and far-reaching legislation is introduced to bring the ideal nearer to realization.

On the 'community' principle there can scarcely be grave disagreement. Traffic safety, social organization, economy, and neighbourliness, all call for it as an element of town improvement. The amazing biological plate facing p. 21 in the book of the London plan shows the social and functional analysis of the communities of the metropolis. Whether the proposed solution is quite functional enough, or whether an intermediate grouping is desirable between the many reconstructed units and the central areas, will only be proved by time. The main theme is a London reintegrated, and not a London rubbed out and redrawn.

Probably the most unconvincing feature of the plan is that of industrial location. It is unconvincing because even the crowded area of the London County Council is a *local* area, and the industry of London is *national* in character. Certain preliminary facts are sorted out, some of them rather surprising; as for example, that the average number of workers per factory in the County was only 20 in 1938, and tha of 37,000 factories and workshops two-fifths were in the clothing industry. The drift from central to less central areas in search of cheaper land, less congestion and better opportunities for expansion, is clearly faced; and in general the plan proposes that industry, which is anyway on the move, should be encouraged to move to the right places, if not to industrial areas prepared and serviced for its reception. The analysis does not go very far, and much remains to be done in calculating the degree of mobility of the industrial complex, its sex and skil ratios, and the extent to which a system of inducement, coupled or not with licensing powers, would bring about the desired pattern shown tentatively on the coloured plate No. 11. More still depends on the policy which the Government adopts when eventually it faces the issues of the Barlow Report, and the extent to which it is prepared to introduce legislation to regulate post-war industrial settlement But since the standards of density which are at the root of the L.C.C. proposals are based on an estimated rate of industrial decentralization, this is evidently a question of major importance, and one which the plan does not—and probably cannot—answer.

The other proposals are all susceptible to change in detail. The roads are mainly Bressey roads, with additions in the shape of through cross-roads meeting in the heart of London and reaching it partly by tunnel. It is always doubtful whether road improvements may not create as much traffic as they facilitate; and here again everything depends on the extent to which the neighbourhood pattern, imaginative zoning, and the estimates of industrial movement prove adequate to the occasion, and reduce the total amount of unnecessary traffic. The distribution system by an "outer goods ring railway", feeding both in and out by road transport, is a useful suggestion. So is the loop line which joins London Bridge, Cannon Street, Blackfriars, Charing Cross and Waterloo, which it is hoped may eventually be put underground and thus eliminate the cross-river railway bridges. This proposal is similar to that put forward by Westminster in evidence to the Royal Commission on Cross River Traffic in 1926; and since forgotten. But all the railway proposals are tentative, and much will depend on the proposals of the railway companies themselves, if and when these are made public.

For the rest, one can only recommend a study of the many fascinating details which the plan discusses, such as the "precincts" of Westminster and Bloomsbury, the relation of shops to road planning (p. 57), the open space proposals (which would remove once for all the worst features of overcrowding in the most congested areas), the riparian treatment of the Thames, the discussion on "period planning" (p. 145), and the very important Appendix I, giving the figures for decentralization.

However specialists may criticize the plan for failure to clarify particular issues, the fact remains that this proposal puts the whole of the L.C.C. reconstruction scheme into scale and into the proper perspective. It is an enormous and an ambitious challenge to public and to Government alike, to face up to the cost and labour that will be required, and to grasp the inspiring opportunity that is presented to them between the covers of this book.

ARCHÆOLOGICAL FINDS FROM GREECE AND CRETE

The Annual of the British School at Athens
No. 40: Session 1939–40. Pp. iv+87+32 plates. (London: Macmillan and Co., Ltd., 1943.) 42*s.* net.

IN spite of the difficulties of the times, the British School at Athens has produced its fortieth Annual, and the only marks of trouble are the reduced number of pages and a paper cover instead of the usual boards. The number of plates and text-figures is generous, and the contents very well indeed up to the mark.

The article of perhaps the most general interest is Mr. Heurtley's on the School excavations in Ithaca, with his summary of conclusions. Guided by the survival of the name, the general reader has always been content to regard the modern Ithaca, or Thiaki, as the island immortalized in the Odyssey, and if the details of the topography could be shown not to it very exactly in all points, he reassured himself by thinking that Homer was writing an epic poem and not a topographical treatise and, in any event, he had his headquarters somewhere in the eastern part of the Ægean and a very long way from the sland of Odysseus: he aimed, that is, at no more than a general local colour which would pass muster with his hearers. But professional topographers, beginning with Gell, had always felt these difficulties and doubts, and the question came very much to the ore with the activities of Dr. Doerpfeld, who loudly maintained that the real Ithaca of Homer was the sland of Leucas, and claimed that his excavaions there had proved his view. It seems not to have struck him that, as Odysseus was only one of a number of island chieftains, it is hard to see how ny discovery of remains of the required period ould clinch the question. Then the British School began to excavate in Ithaca, and found that it had been inhabited all through the required period, and hus, quite apart from tradition, was no worse off as a candidate for Homeric honours than any other of he neighbouring islands. Finally, the School found a broken mask of the first century A.D. inscribed with the name of Odysseus, to say nothing of potsherds bearing the word *nymphs*. Mr. Heurtley sums up the whole question in his final remark, a model of ommon sense: "To the doubt as to how Odysseus' name came to be associated with Ithaca, the answer is perhaps the simple one, that it was really his home, and it was there that the events took place which supplied the material for Homer's description of the Return."

Of the other articles—there are in all seven—two deal with East Crete. One by Mr. Hutchinson, Miss Eccles and Miss Benton, is devoted to some objects still left unpublished from the excavations at Praisos nd Palaikastro, which began so long ago as 1902. The other is on Dicte and the Temple of Dictæan Zeus; it is a memorandum written before 1910 by the late Prof. R. C. Bosanquet, which seems to have been intended as a historical introduction to the definite report of these excavations at Praisos and Palaikastro, of which this volume contains the aftermath. It is a learned topographical and archæogical study of the whole of East Crete, the Siteia Peninsula, written by one who knew the country well, and it was due to his memory that it should be published. In it are embedded notes of a visit which he paid in 1903 to the island of Kouphonisi off the southern coast of the peninsula, with an account of the remains, Minoan and later, which he found there. Mr. Hutchinson has enriched this study with a note: Where was Dicte?

Other articles are an epigraphical study by J. M. R. Cormack, "Royal Letters in Beroea", a paper by Miss Benton on the dating of early Greek armour, and a long paper by Anton E. Raubitschek, "Early Attic Votive Monuments". This has an interesting note on the sculptor Euenor, the master of Pheidias, and a statue of Athena which might be a work of Euenor, or even (but here the author expresses himself with great caution) of Pheidias himself in his young days.

The last article is by Prof. J. D. Beazley: "An Archaic Greek Statuette from South Arabia". A British officer was riding in the Aden Protectorate and was offered a bronze statuette, five inches high, of a warrior, wearing corslet, helmet and greaves. To buy it was not possible, but a photograph was secured, and an enlargement is here reproduced. The work has every appearance of genuineness, and Prof. Beazley says it would be "good Greek work from the middle of the third quarter of the sixth century B.C.; Peloponnesian and very possibly Laconian". Nothing else of this sort seems to have been found in Arabia, and it well illustrates the never to be forgotten maxim that single finds of almost any sort of object may turn up almost anywhere: certainly few are more astonishing than this one. Apparently the tribesman still has it, unless he has found a passing customer with more ready money in his pocket.

In conclusion: though the volume is slim, the quality is high, and the British School at Athens is to be heartily congratulated on its appearance.

R. M. DAWKINS.

THE FREE WILL CONTROVERSY

The Free Will Controversy
By Dr. M. Davidson. Pp. ix+118. (London: Watts and Co., Ltd., 1942.) 7*s.* 6*d.* net.

A FEW years ago Dr. Davidson published a work entitled "Free Will or Determinism", which was devoted almost entirely to an exposition and discussion of the bearing of modern science on one of the oldest and most perplexing of philosophical problems. Some readers at least felt that the effectiveness of this work suffered somewhat from the lack of a historical setting, and this lack has now been supplied in the volume under review. In a small compass the thoughts of men on the free-will problem have been traced from the early Babylonian astrologers, through Greek, Roman, Hebrew and Christian philosophy, the doctrines of Descartes, Spinoza, Leibniz, Hume, Kant, Mill and Haeckel, to their present preoccupation with the implications of physics and biology. There is a "Conclusion", rightly so called in the sense that it ends the work, but containing no attempt to sum up the evidence or to pronounce a verdict. The treatment throughout is strictly objective and non-partisan, the writing is clear and interesting, and the volume forms a necessary and very useful supplement to the earlier book.

It would be easy but unjust to stress the fact that important omissions have been made. The author is well aware of this, and has, in addition to the obvious defence of its intrinsic inevitability, the further defence that paper restrictions imposed a maximum size on the book. Considering the limits allowed him, it is difficult to see how Dr. Davidson could have made a better choice of material, except that some reference might have been made to the effect on general thought—an effect not completely represented in the standard philosophies of the period—of the mechanistic character of physical science during the eighteenth and nineteenth centuries, for it is only in relation to this that the claims made that modern physics has emancipated us from the chains of "necessity" have any significance. The argument was, briefly, that the movements of matter had been proved to be controlled by universal laws, that human actions were movements of matter, and that therefore human actions were controlled by laws which operated independently of the will of the human being. It was a very weak argument at the best, for the one recognizable distinguishing characteristic of living matter was that it did *not* move according to the laws found valid for non-living matter. Nevertheless, the prospect seemed to cause serious perplexity, and the modern discovery that the laws of motion of non-living matter cannot be effectively used for conceptual entities like electrons unaccountably gave great comfort by making it seem possible that, after all, our bodies after we are dead might not be quite inevitably under the control of physical law. Why this is more consoling than the obvious fact that they are not so controlled while we live would be a suitable theme for Dr. Davidson's next book if psychology is included among his many interests.

H. DINGLE.

THE COMING-OF-AGE OF INDUSTRIAL PSYCHOLOGY

An Introduction to Industrial Psychology

By May Smith, D.Sc. Pp. 264. (London, Toronto, Melbourne and Sydney: Cassell and Co., Ltd., 1943.) 7*s*. 6*d*. net.

PRESENT-DAY psychology can be understood only in its historical setting, which Dr. May Smith outlines in her first chapter, for modern advance in science had strengthened an attitude—even now persistent in some degree—unfavourable to psychological ways of thought. Stahl, "the last of the animists", possessed a knowledge of psychology that had to be rediscovered in our day, and with his defeat the subject was banished from medicine, the branch of science that needs it most. Yet it would not keep out. A century after Stahl there came Mesmer with his theories of magnetic fluids to account for psychological phenomena; another century passed and Charcot, with his *grande hysterie* and metallotherapy, was discredited in his turn. Freud at last provided an understanding of these and other clinical problems, but we were still in the dark age of psychology, and not until the War of 1914–18, with its thousands of breakdowns, was medicine compelled to acknowledge its existence. On the academic side psychology had been a branch of philosophy, but workers like McDougall, with his postulation of instincts as a driving force, were approaching a common groun with Freud; the two lines of descent came togethe and psychology became an integral part of medicine at the same time finding wide application outsid that field.

The author comments, after referring to an earl writer on what we now call vocational guidance "One cannot but regret that this part of his wor did not receive the attention it deserved, but th 17th century had something else to consider, and caught by the exciting drama of the rapid advance in chemistry and mechanics, paid little heed to th suggestions of a writer whose interest was in men' minds".

What was true in the seventeenth century was tru in the nineteenth. Industry had grown up unde economic laws that, though some of their result were softened by legislation, were accepted as no only necessary but also sufficient to ensure th efficiency of the worker. His happiness and contentment were his own private affairs. There was n room for psychology here, but again the War o 1914–18 led to a fundamental change, and under it stimulus was set up the Health of Munition Workers Committee, which gave origin to the Industria Health Research Board and marked the beginnin of great developments in the study of huma problems in industry. In these developments D May Smith, who had been a pupil and fellow-worke of McDougall, has taken an important part, and fe can be better qualified to write a survey of this many sided subject.

Fatigue, the first subject of systematic study, ca be measured by tests and estimated by outpu figures, but, in bringing earlier work into relatio with experience after Dunkirk, Dr. Smith strikes note that prevails throughout the book, and tells u what the workers feel and think. "We shall have t pinch time off if we don't get it" is a sentiment th psychologist would teach us to accept as a factor i absenteeism. Moreover, the ability to listen easil to the expression of such sentiments is essential i the study of problems that appear to be purel physiological—such as lighting, temperature, noise rest pauses, and the like. An account is given, wit references, to work done on these topics, and o accident proneness, training, and vocational guidanc and selection. The chapter on time- and motion study gives full credit to its originator, F. W. Taylor but it is noted that his work was subjected to sever criticism, which arose from his frank acceptance o American economic theory and practice as the existed in 1911, and found its focal point in th phrase 'the number of men required was reduced' Dr. May Smith's thesis is that industrial psycholog gives first consideration to the happiness and well being of the worker, productive efficiency being the natural sequel.

Dr. May Smith's own work led her to the stud of the nervous temperament and its influence upo efficiency and sickness, which she describes with lively human touch. The medical reader will fin here a fuller treatment of the subject than his ow text-books provide, a treatment aided by unobtrusiv psychological knowledge combined with wide experience. The book is an authoritative and up-to date account of the whole subject, and not onl satisfies an urgent need in our present trials but als offers valuable guidance in those new adjustment that will be inevitable when the War shall hav ended.

MILLAIS CULPIN.

EDMOND HALLEY AND GEOMAGNETISM*

By PROF. S. CHAPMAN, F.R.S.
Imperial College of Science and Technology

MY subject is really Halley's geomagnetic work considered in its historical setting, but I wish first to say a little about Halley as poet—a seldom remembered aspect of his remarkable versatility.

Halley's Latin Verses

Halley is known to have written three poems, all in Latin†. The first and major poem, consisting of forty-eight hexameters, was written when he was thirty or thirty-one. It is in praise of Isaac Newton, and was prefixed to the "Principia", which Halley published at his own expense and care. As Prof. H. C. Plummer showed in his Halley Lecture[1] last year, the supreme merit of Newton's work was not immediately and universally recognized. But Halley was in no doubt, and we may imagine his joy and satisfaction in being privileged to evoke Newton's immortal work and to bring it before the world. The hexameters are written in this spirit. In the second edition of the "Principia", edited by Roger Cotes, Bentley amended some of Halley's lines, without leave; in the third edition, edited by Pemberton in 1726, Halley restored most of the original readings[2].

As Latin is now less commonly understood than in Halley's time, I venture to give an English version of this poem made by my wife. This is naturally less concise than the original; the forty-eight Latin lines become sixty-eight in the English.

The poem mentions many of Newton's main discoveries, and describes how Newton has enlarged man's powers and raised him still further above the animals. Finally, it acclaims Newton himself as having done more for mankind than any of its moral and social leaders or the discoverers of the useful arts, placing him of all men next to the Deity.

To the Honour of
this mathematical-physical work
of the most excellent
ISAAC NEWTON
a signal glory of
our Century
and of our human
Race.

Behold, to thee the Rule that guides the Pole,
To thee the balance of the Massive Whole,
To thee the Skies, Jove's holy seat sublime,
Count out their numbered path through Space and Time.
By what Set Laws the All-Father has confined
His own Creative Act thou hast divined,
Hast shewn wherein the Great Creator laid
The Firm Foundation for the world he made.
The Inmost Secrets of the Conquered Sky
Lie open to thy wise discerning eye;
And that same Wisdom all undaunted probes
The Force that spins around the furthest globes.
The Sun commands all things, descending prone
To rush towards him, seated on his throne;
The Starry Chariots suffers not to trace
Straight Paths through the Enormous Void of Space;
Himself the Centre, drawing each, he sways
The Ordered Circuit of their Starry Ways.
Known now the Path the Dreadful Comets weave;
The Bearded Stars no more our minds can grieve.
Wherefore the Silver Moon with varying gait
Speeds on, from thee we learn, though learning late;
Know how she hid, until thy wiser days
The secret of the Curb which She obeys.
We learn from thee wherefore her nodes regress
And why her apses ever forward press.
When Wandering Cynthia doth the sea compel
How Great the Force thy doctrine now can tell,
Measure her Strength, when tired waves leave the shore
And show the sailor sands he guessed before,
Or when, in turn, returning on their way
They seek the utmost marge, beneath her sway.
Those problems which the ancient scholars vexed
Those noisy contests which the Schools perplexed
Plainly we solve—thy lore dispels the cloud
And, by dull error now no head is bowed.
For us thy wit has trod Celestial Ways
And shown the steps of heaven to our gaze.
Mortals, arise! shake off your earthly cares
This Man our Heavenly Origin declares
For fellow minds of such a Master Mind
Are far removed from all the Brutish Kind.
Less did they raise to better things our life,
Our human life, who taught that bloody strife,
That theft, adultery and fraud's wicked guile
Are cursed, and wrote their Lore with graver's stile.
Less he, who to fierce tribes that wandered rude
Taught city life and their wild fears subdued,
Bade them live safe, held in a wall's strong arm.
Less he, who taught the hungry folk to farm.
Less he, who pressed with new devised craft
From the sweet grape her care-dispelling draught.
Less he who, plucking the Nile-watered reed,
Made from it paper, wrote thereon his screed
To painted picture linking spoken sound.
All these for human woes great solace found,
But we of Superhuman Joys are free.
We know the Law that guides the poles, we see
The hidden secret of dark earth unsealed
And Matter's Changeless Ordering revealed.
Such knowledge, hidden from an earlier age,
Is now, through thee, to us an open page.
O Muses, sing with me this Great Man's praise
Ye who are fed with nectar, tune your lays.
Newton, to Truth's locked Shrine has found the Key,
Newton whose heart is pure, in whom we see
The Godhead's Favoured Friend to whom is given
The Nearest Place a man may win to Heaven.

Halley may have written another poem[3], now lost, in the year 1687 when the "Principia" was published. His two other known poems appeared thirteen years later, on his famous world magnetic chart; this, too, must have been for him a time of great joy in achievement. One poem was in praise of Queen Anne, and is now of little interest; the other, as follows, of much greater artistic merit, lauded the unknown inventor of the compass[4].

Him who first taught with magnetism to imbue
The iron: and the ocean's watery waves
Made clear to ships erst doubting: him who linked
Shores, tell his time far sundered, and by wind
Brought mutual products to remotest lands.

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* Halley Lecture delivered at Oxford on May 28.

† Halley also used Latin in his first paper in the *Philosophical Transactions of the Royal Society*, in his Catalogue of the Southern Stars, and occasionally in later papers. Hevelius, in a letter of July 5, 1670, to the Royal Society, published in the *Phil. Trans.* for that year pp. 2059–2061), opens with the sentence: "Would to God, that hose Excellent Books that are publish'd in English, were, for the benefit of the whole Learned World, made Latin."

A thankless day, a heedless age have hid.
No mighty name survives him, being dead.
Hope not to wrest thy fame from Stygean shades
Nor seek to win thy ashes honours due.
And yet—to know within thy secret heart,
A shell surpassing common mortals, to have blessed
The life of far-off grandsons, is not this
Itself the Elysian fields, the shining crown ?

The Magnet and the Compass

The science of geomagnetism has a long history. In our time its earlier phases have been studied especially by Crichton Mitchell[5], and in the preceding generation by Hellmann[6] and Sylvanus Thompson[7].

The attraction of iron by the magnet or loadstone was known to antiquity, and is mentioned by Plato and many later writers[7]. The directive property of the magnet was discovered much later ; Crichton Mitchell[5a], after reviewing the available evidence, concludes that it was certainly known to the Chinese in the eleventh century, and in Europe in the twelfth. A Chinaman, Shon-Kua (A.D. 1030–93), wrote that "fortune-tellers rub the point of a needle with the stone of a magnet in order to make it point south". Before 1200 Alexander Neckam, a monk of St. Albans, described the mariner's compass, in which a magnetic needle swings on a pivot, as being in common use.

The compass points south, said the Chinaman, north, said the Europeans ; both were right. Though the choice is arbitrary, it affected men's ideas as to the cause. In Europe the Pole Star was often supposed to attract the north end of the needle.

Nowadays a boy's first lesson on magnetism describes the dipolarity of magnets, the north and south poles (named by means of the directive property), the repulsion of like poles and the attraction of unlike. Petrus Peregrinus in 1269 gave the first-known systematic record of these facts, in a letter[8] from Italy to a home friend in Picardy. Manuscript copies spread the knowledge ; the letter was not printed until 1558. Though it includes a description of an ingenious magnetic perpetual motion machine, the letter is generally clear and modern in spirit ; Petrus wrote from actual experiment, mostly using loadstones cut to the spherical form.

Magnetic Declination

The recognition of the magnetic declination* as a general fact of Nature came only gradually. The declination of the compass from the true north cannot be measured without first determining the meridian at the place of observation, and this requires skill. At first the declination was ascribed to faults in the magnetic needle or in the measurement. Even in 1701 two needles used by Halley on his magnetic voyages gave readings of the declination at London that differed by 20′ ; in the fifteenth and sixteenth centuries the errors in magnetic azimuths might be a few degrees. Nowadays at magnetic observatories the declination is read[9] to 0·1′, though this requires great skill and care.

Our earliest dated records of the magnetic declination are not written ones. In the fifteenth century, portable sun-dials[10] were used by travellers and others to tell the time ; they included a magnetic compass by which to set the noon line. Some dial maker who had determined his true meridian must have noticed that the magnetic setting was erroneous, so he put a mark on his dials to which the needle should point. The angle between this mark and the north point of the dial showed the declination, as reckoned by the maker. Dated dials made at Nuremberg at about 1450 show that the declination there was then about 7° E.

A little later, before 1500, road maps made by Etzlaub of Nuremberg[11] bear instructions for their use in association with the traveller's compass, and show clearly that the declination was known. A compass card printed on one such map has an arrow pointing 11¼° E. (one-eighth of a quadrant, the smallest unit then commonly used in stating wind directions).

Crichton Mitchell[12] has carefully examined the statements often made that Columbus, on his West Indian voyage in 1492, discovered the declination or the fact that it is not everywhere the same (ref. 6*a*). He concludes adversely on both points, stating that Columbus misinterpreted the differences observed between his compass readings ; he also rejects similar claims made on behalf of the Cabots.

Measuring the Declination

The first printed instructions for measuring the declination were given in the earliest printed treatise on navigation, by a Portuguese writer Falero[13], in 1535. They were mainly astronomical, to determine the true meridian. Magellan seems to have taken a manuscript copy of this book with him in 1519 on his voyage round the world. The first notable series of forty-three observations of the declination were made by the great Spanish navigator de Castro, in a voyage to the East Indies and the Red Sea, 1538–1541. The custom spread to later navigators, and knowledge of the declination in various seas slowly grew.

But this knowledge was very imperfectly diffused, and many landsmen and seamen in other countries remained ignorant of the methods used and the observations made by the navigators of Spain and Portugal. Most writers on magnetism and dials up to 1600 fail to refer even to the existence of the declination[14].

The earliest known written record of the declination gives it for Rome, 6° E., in 1510. It occurs in a letter[15] sent by Georg Hartmann in 1544 to Duke Albrecht of Prussia ; the measurement was made while Hartmann, a mathematician, instrument maker, and later vicar of a Nuremberg church, was studying in Rome. In Nuremberg, when he wrote, he found the declination to be 9° or 10° E.

This letter contains also the first mention of the magnetic dip. It describes how a needle perfectly balanced before it was magnetized dipped about 9° after being stroked by the loadstone. Hartmann contented himself with this private mention of his observation, which he regarded as one more wonder and mystery of the magnet ; the dip must really have been much more than 9°. The letter remained unknown in the Königsberg archives until 1831.

In 1581 Robert Norman, a London seaman and instrument maker, published "The Newe Attractive", a small book said by Hellmann to be the first printed work purely on geomagnetism. It announced the discovery[16], probably in 1576, of the magnetic dip, which Norman gives as 71° 50′.

The book also describes new experiments of great interest. Norman showed that, when care is taken, a floating compass is not drawn bodily northward, but only turns on its centre ; hence, said he, earlier writers erred in discussing where lies the *poin*

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* Or magnetic *variation*, as it is called by seamen and many old writers on geomagnetism.

attractive of the compass; the compass is not attracted to any point, but there is a point which it respects and turns to; so he discarded the old term *point attractive* for his new term *point respective*.

In making this important distinction he did not discriminate between the whole compass and its northern end, to which he, like earlier non-Chinese writers, gave a preference. As the northern end dipped, he located the point respective in the earth.

Important ideas were struggling to birth in the mind of this practical seaman and mechanic, more discerning than Hartmann. He was right in concluding that the earth, not the heavens, directed the magnetic needle; but his argument was faulty in that it depended on an unconscious preference for the north end of the needle. The idea of a couple acting on the needle still lay far in the future, beyond even Halley a century later.

William Gilbert, Queen Elizabeth's physician, laid a firmer foundation for Norman's conclusion. In the great treatise "De Magnete" (1600), Gilbert announced that the earth itself is a great magnet. This book, written in Latin, describes a great variety of his own experiments, and clearly distinguishes between magnetic and electric attractions. Gilbert chiefly used spherical loadstones, like Petrus Peregrinus three and a half centuries before; he carefully explored how tiny magnetic needles, free to turn on their centres, set themselves when placed at different points near such a stone or terrella. He found that at the 'equator' of the stone, midway between its pôles, the needle would lie along the surface, whereas nearer the poles one or other end would dip; by means of the needles, he marked out on his terrella, with chalk, the magnetic meridians or lines of horizontal magnetic force, converging to the two poles.

He pointed to the analogy between the poleward direction of these little needles on the sphere, and the northward direction of compass needles on the earth. He fortified the analogy by Norman's observation of the magnetic dip*, roughly equal to the dip of his own little needle on the sphere, when placed in a similar 'latitude'. As the magnetism of the terrella obviously controlled the direction of his needles, he inferred, as Norman had done, but now with more reason, that the earth controls the direction of the compass or dip needle. Going beyond Norman, he realized that the earth itself is a great magnet.

Thus he showed that the directive property of the magnet, which hitherto had been regarded as a phenomenon distinct from its attractive or repulsive action, was really only a manifestation of the same power, in relation to the earth magnet, the bigness of which had until then hindered this recognition.

Gilbert commended Norman's rejection of the old idea of a *point attractive*, but himself rejected Norman's *point respective*, because the little needles, placed at different points on the terrella, met in no common point. The whole earth, he said, exerts the directive power, not merely the centre or any other single point.

Distribution of the Declination

Falero, in the treatise already mentioned, stated without any warrant from observation that the magnetic declination was distributed regularly over the earth. At that time the declination was zero at one of the Azores. Falero said that, going eastward from this meridian, the declination would be east, and would regularly increase over the first 90° of longitude; thence it would regularly decrease to zero in the next 90° of longitude; in the 180° of west longitude the declination would be westerly and would vary in the same way.

Gilbert knew that its distribution was less regular than this. He quoted (Bk. IV, Ch. 1) the declination at London and elsewhere, and concluded that the earth's directive power was defective over the oceans (water being non-magnetic) and stronger where the land was elevated. He regarded these inequalities as disturbing the tendency of the needle towards the magnetic poles, which he supposed to coincide with the geographical poles. Halley afterwards disproved Gilbert's theory, showing that at sea the needle may point away from an adjacent continent.

Gilbert and the Magnetic Dip[17]

Gilbert also erred like Falero in thinking that the earth's magnetism is more regular than is the fact; but Gilbert's error concerned not the declination but the dip. He supposed that the dip depends only on the latitude, and would enable seamen to determine their latitude when clouds covered the sky. He gave an empirical theory for the magnitude of the dip, and Briggs of Gresham College, at Gilbert's suggestion, calculated a table of dip and latitude on this theory. Kircher, a Jesuit writer on magnetism, in 1643 gave a table[18] of computed and observed dips. Further discovery showed that the method was impracticable.

It is remarkable, in view of the importance of the dip in Gilbert's demonstration that the earth is a great magnet, that he quoted not one actual observation of it, neither Norman's nor any made by himself, though he invented a simplified portable dip circle[19].

Gilbert made the further unfounded assertion that at any one place the declination remains constant, unless changed by some great cataclysm like the fabled submergence of Atlantis. This was disproved in 1634 by Gellibrand[20], Gresham professor, who found that the declination at London was then only 4·1° E., quite irreconcilable with the value 11·3° E. measured in 1580 by William Borough[21].

Thus the secular magnetic variation came to light, which imposes on us the duty, both for science and practice, continually to repeat the magnetic survey of the globe. The earth's magnetism has changed greatly in the three centuries since then, and its future, uncertain and mysterious, remains to be observed by later ages.

Halley and his Magnetic Needle

The story of magnetic discovery has now brought us to the time of Halley[22,23], who was born in 1656[24]. While still at St. Paul's School, he decided to devote his life to astronomy, which he did to such effect that his name will ever live in the annals of that science. But geomagnetism was one of his favourite secondary interests. In 1672, while only sixteen and at school, he measured the magnetic declination in London; it was 2° 30′ W., showing a further westward change of $6\frac{1}{2}°$ since Gellibrand's observation. The laying down of the meridian for this measurement fitted in well with Halley's astronomical interests.

At Oxford, Halley planned an expedition across the equator to observe the southern stars, and in 1676 he was enabled to go to St. Helena, through the good offices of the Royal Society, King Charles II.

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* Gilbert called the declination the *variation*, and the dip the *declination*.

and the East India Company. There he spent a year (1676–77) most fruitful for astronomy. He took his magnetic needle with him, besides his astronomical equipment, and observed the declination[25,26] at St. Helena and Ascension.

Not long after his return to England and the publication of his results, he paid an astronomical visit to Hevelius* at Danzig, where again he appears to have used his compass[25]. A little later he set out from England to make the grand tour with a friend; while in Paris and Rome he observed the declination[26]. In London, at Gresham College, then the home of the Royal Society, he often repeated his measurement[27], for example in 1683, 1692, 1701, 1702, and 1716. In 1696, when he went to Chester as deputy controller of the Chester Mint, he again took his magnetic needle with him[28]. These observations clearly show his long-continued interest in the earth's magnetism.

Halley's Theory of the Variation (Declination)

In 1682 Halley married and settled down in London. The next year, when he was twenty-seven years of age, the Royal Society published his famous theory of the distribution of the declination[25]. His aim was "to reconcile the observations by some general rule", not, as Des Cartes[29] did, by "causes altogether uncertain (as are the casual lying of iron mines and loadstones in the earth)", which to Halley seemed to "put a stop to all further contemplation, and give discouragement to those that would otherwise undertake this enquiry".

"Tis true," he said, "that not long since one Mr. *Bond*[30], an old teacher of navigation, put forth a small treatise wherein he pretends to calculate the variation." Bond's theory merely supposed the magnetic axis of the earth to be oblique to the geographical axis, so that the declination could be readily calculated anywhere. Halley saw that this theory requires the declination to have the same sign all along each geographical meridian, and showed that this did not agree with observation[31].

Halley then gave a table of dated observations of the declination, made by "persons of good skill and integrity", at forty-eight places in many parts of the globe. He showed that these did not confirm Gilbert's theory that at sea the compass would always turn to an adjacent mainland. As to Des Cartes, Halley admitted that some local irregularities of the declination, like those near Elba, might be explained by local deposits of iron ore; but he said that no reasonable amount of it could explain why the needle declines the same way all over great areas such as the whole Indian Sea. "Besides, against both Des Cartes and Gilbert, the change of the variation, which has been within this hundred years last past more than 15 gr. at London, is an entire demonstration: tho Des Cartes does not stick to say, that the transportation of iron from place to place, and the growth of new iron within the earth, where there was none before, may be the cause thereof."

Halley himself, "after a great many close thoughts", and wishing to "introduce nothing strange in philosophy", could "come to no other conclusion than that, *The whole globe of the earth is one great magnet, having four magnetical poles, or points of attraction, near each pole of the equator two, and that, in those parts of the world which lye near adjacent to any one of these magnetical poles, the needle is governed thereby, the nearest pole being always predominant over the more remote*".

Halley gave the positions of the four poles, "as near as conjecture can reach", "for want of sufficient data to proceed geometrically"; and he indicated the four regions, each governed mainly by one of these poles. He ended with the following admirably moderate remarks[32] on the declination:

"But to calculate exactly what it is, in any place assigned, is what I dare not yet pretend to; . . ., for first there are a great many observations requisite. . . . And besides it remains undetermined in what proportion the attractive power decreases, as you remove from the poles of a magnet; without which it were a vain attempt to go about to calculate. There is yet a further difficultie, which is the change of the variation, one of the discoveries of this last century: which shows, that it will require some hundreds of years to establish a compleat doctrine of the magnetical system . . . it should seem, that all the magnetical poles had a motion westward: but if it be so, tis evident that it is not a rotation about the axis of the earth . . . But whether these magnetical poles move altogether with one motion, or with several, . . . are secrets as yet utterly unknown to mankind; and are reserved for the industry of future ages."

Halley's Experiments on the Law of Magnetic Attraction

In 1687 Halley made experiments[33] to determine "in what proportion the attractive power decreases, as you remove from the pole of a magnet"; this was one of the needs that hindered the completion of his theory. But his work was inconclusive; the discovery of the inverse square law of force between point magnetic poles did not come until a century later. In Halley's time several necessary theoretical conceptions were wanting—the point pole, the point dipole, the magnetic moment, the couple. Newton might have developed these had he given his close attention to magnetism; but Halley, who did so much in connexion with Newton's "Principia"*, seems never to have inspired Newton with his own strong interest in magnetism.

Halley's Theory of the Secular Magnetic Variation

In 1692 Halley, aged thirty-six, extended his theory to explain the secular magnetic variation[26]. He said that his theory of the declination had been well received at home and abroad, but he found two difficulties not easy to surmount. One was that no magnet he had ever seen or heard of had more than two poles, "whereas the earth had visibly four, and perhaps more". The second was that "these poles were not, at least all of them, fixt in the earth, but shifted from place to place"; "whereas it is not known that the poles of a loadstone ever shifted their places in the stone, nor (considering the compact hardness of that substance) can it easily be supposed.

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* Hevelius also was interested in the magnetic declination, and in a letter to the Royal Society (*Phil. Trans.*, 5, 2059–2061; 1670) mentions his own observations of the declination at Danzig in 1628, 1642 and 1670.

* Newton's "Principia" contains only five brief references to magnetism; in Axioms, Corollary 6; Book 2, Section 5, Theorem 18; Book 3, Theorem 6, Corollary 5; Theorem 7, Corollary 1; Problem 18, Corollary 10. The third of these references includes the sentence: "The power of magnetism . . . in receding from the magnet decreases not as the square but almost as the cube of the distance, as nearly as I could judge from some crude observations". Newton in 1712 (see ref. 23) made the same remark, when proposing, as president of the Royal Society, that Halley and Hawksbee should make new experiments on the subject.

"These difficulties had wholly made me despond, and I had long since given over an enquiry I had so little hopes of; when in accidental discourse, and least expecting it, I stumbled on the following hypothesis:

"Now considering the structure of our terraqueous globe, it cannot be well supposed that a very great part thereof can move within it, without notably changing its centre of gravity and the equilibre of its parts, which would produce very wonderful effects in changing the axis of diurnal rotation, and occasion strange alteration in the sea's surface, by inundations and recesses thereof, such as history never yet mentioned . . . So that the only way to render this motion intelligible and possible, is, to suppose it to turn about the centre of the globe, having its centre of gravity fixt and immoveable in the same common centre of the earth: and there is yet required that this moving internal substance be loose and detached from the external parts of the earth, whereon we live; for otherwise were it affix'd thereto, the whole must necessarily move together.

"So then the external parts of the globe may well be reckoned as the shell, and the internal as a nucleus or inner globe included within ours, with a fluid medium between. Which having the same common centre and axis of diurnal rotation, may turn about with our earth each 24 hours; only this outer sphere having its turbinating motion some small matter either swifter or slower than the internal ball."

Both the exterior shell and the nucleus were supposed to have their poles distant, by different amounts, from their poles of rotation. The exterior shell, with its magnetic poles fixed, might also have an unequal or irregular distribution of its magnetic matter, explaining the local irregularities in the distribution of the declination. The relative motion of the magnetic nucleus, or, should future observations require it, of the nucleus and additional inner shells, may explain the secular variation, though "it will be very hard to bring this hypothesis to a calculus".

Halley conjectured that the whole period of the secular variation is "700 years, or thereabouts; so that the nice determination of this and of several other particulars in the magnetick system is reserved for remote posterity; all that we can hope to do is to leave behind us observations that may be confided in, and to propose hypotheses which after ages may examine, amend or refute. Only here I must take leave to recommend to all masters of ships and all others, lovers of natural truths, that they use their utmost diligence to make, or procure to be made, observations of these variations in all parts of the world, . . . , and that they please to communicate them to the Royal Society, . . ."

Halley then answers various objections which he foresaw: one was that there is no instance in Nature of the like thing, and that if there were, the nuclei and shells would not preserve the same centre. To this he answers that the ring of Saturn is a notable instance somewhat of this kind. Another objection was that water would leak through the outer shell.

"To those that shall enquire of what use these included globes can be, it must be allowed that they can be of very little service to the inhabitants of this outward globe; nor can the sun be serviceable to them, either with his light or heat. But since it is now taken for granted that the earth is one of the planets, and they all are with reason supposed habitable, though we are not able to define by what sort of animals; and since we see all the parts of the creation abound with animate beings, . . . , all whose ways of living would be to us incredible did not daily experience teach us. Why then should we think it strange that the prodigious mass of matter, whereof this globe does consist, should be capable of some other improvement than barely to serve to support its surface? Why may we not rather suppose that the exceeding small quantity of solid matter in respect of the fluid ether, is so disposed by the Almighty Wisdom as to yield as great a surface for the use of living creatures as can consist with the conveniency and security of the whole. We ourselves, in cities where we are pressed for room, commonly build many stories one over the other, and thereby accommodate a much greater multitude of inhabitants."

Lastly, he explains a diagram showing a nucleus and three shells, the nucleus being about 2,000 miles in diameter, and the thickness of each shell, and of each hollow between, about 500 miles, so that the four upper surfaces are "nearly proportionable to the magnitudes of the planets" Mercury, Mars, Venus and, of course, the earth.

"Thus I have shewed a possibility of a much more ample creation, than has hitherto been imagined; and if this seems strange to those that are unacquainted with the magnetical system, it is hoped that all such will endeavour first to inform themselves of the matter of fact, and then try if they can find out a more simple hypothesis, at least a less absurd, even in their own opinions. And whereas I have adventured to make these subterraneous orbs capable of being inhabited, 'twas done designedly for the sake of those who will be apt to ask *cui bono* and with whom arguments drawn from *final causes* prevail much."

Comments on Halley's Magnetic Theories

How are we to regard this remarkable theory? To us, and probably to some of his contemporary critics, it has some flavour of Kepler in his wilder moments. Halley himself said: "If I shall seem to advance any thing extravagant or romantick, the reader is desired to suspend his censure, till he have considered the force and number of the many arguments which concurr to make good so new and so bold a supposition". A sign that Halley always remained satisfied with these arguments is that a portrait painted in 1736, when he was eighty, shows him holding his 1692 diagram of the earth's nucleus and its shells.

The force and ingenuity of his arguments cannot be gainsaid, and they must be judged by the standards of knowledge and ignorance at the time they were written. But our knowledge of geophysics, especially of seismology, now precludes Halley's hypothesis.

What is more pertinent, however, is that Halley might have found for himself, by experiments like those of Petrus Peregrinus and Gilbert, using loadstones in the form of a sphere and spherical shells, that his hypothesis would not work. The theory of uniformly magnetized spherical shells still lay far in the future, but this experiment was quite open to Halley, and would have shown him that despite the differing directions of the magnetic axes of the nucleus and shells, the field at the outer surface would have only two poles.

We know now that despite the irregular distribution of the earth's field, there are only two magnetic poles*, to which converge all the magnetic meridians (drawn as Gilbert did on his terrella). Halley's own later knowledge would have enabled him to draw many of these meridians, and to discover this fact. The first actual chart of the earth's magnetic meridians was made in 1817 by another Englishman, Thomas Yeates[34].

The irregularities of the earth's field imply a more detailed irregularity in the inner causes than Halley's hypothesis suggested, and the secular variations are regional in character, not so regular and world-wide as he supposed.

The causes of the main field, of its irregularities, and of its secular variation, are still unknown. It seems likely that the secular variation is connected with convective motions inside the earth, the substance of which becomes first plastic, and then liquid, with increasing depth.

Halley's Magnetic Voyages and Charts

Halley's magnetic theories extended and maintained interest in magnetic observation. Already in 1692 Halley was associated[35] with a plea by Benjamin Middleton, a fellow of the Royal Society, for the Society's assistance "to procure for him a small vessell of about 60 tuns to be fitted out by the Government, but to be victualled and manned at his own proper charges. And this in order to compass the globe, to make observations on the magneticall needle, &c. The President in the name of the Society promised to use his endeavours towards the obtaining such a vessell".

This plan came to nothing, but in 1698 Halley was granted a vessel, the *Paramour* pink, by King William III, "to improve the knowledge of the longitude and the variations of the compasse". Moreover, this landsman of forty-two was put in command of the vessel, with a captain's commission in the Royal Navy—a remarkable event which his deeds well justified. He sailed in November 1698, but trouble with an insubordinate lieutenant caused him to return from the West Indies the following summer, without having crossed the equator. He set off again in September 1699, and after a magnetic survey of the North and South Atlantic down to a high southern latitude he returned in August 1700[36]. In 1701 he published his first chart of the declination over the Atlantic Ocean. In 1702, having collected further observations by mariners in other oceans, he produced a world magnetic chart[37].

These famous charts are Halley's greatest contribution to geomagnetism; they give the declination in a way[38] very convenient to the navigators for whom they were made, and by whom they were widely used for forty years. In time, as Halley foretold, their practical value came to an end, owing to the secular magnetic variation, and new charts replaced them. But the value of Halley's observations as a record of the declination at the epoch 1700 remains imperishable.

One may lament, however, an astonishing gap in Halley's geomagnetic work, his apparent total neglect of the magnetic dip—a fact most surprising in view of his great geometrical knowledge and insight, and of the importance given by Gilbert to the dip in his demonstration that the earth is a great magnet. The dip circle is a more difficult and less accurate instrument than the compass, but its reference direction, the horizontal, is much more easily obtained than the meridian needed in observing the declination. Had Halley observed the dip as well as the declination our debt to him would have been doubled; but where so much is owed, gratitude and admiration must far outweigh these vain regrets.

Halley's Later Geomagnetic Work

At least as late as 1721, Halley's published papers manifest his continued interest in geomagnetism. He became the channel by which many observers sent their magnetic measurements to the Royal Society. He likewise presented and discussed many series of observations of two great auroras visible in London, in March 1716 and November 1719. He acutely recognized some of the relations between the auroras and the geomagnetic field, both as regards the location of auroras in high magnetic latitudes and the parallelism of their rays with the magnetic dip needle.

Halley seems to have contemplated further magnetic voyages, because in 1705 Leibniz[39], replying to an astronomical inquiry from Halley, who had then become Savilian professor of geometry at Oxford, genially expressed the hope that younger men would be found to take over the further little excursions of a few thousand leagues which Halley had been considering, to complete his solution of the great magnetic enigma.

But for two centuries Halley had no comparable successor in this field, and the magnetic survey of the globe was not renewed with his abounding zeal until in 1905 the young American, Louis Bauer, with the backing of a prince of industry, the one-time poor Scots lad Andrew Carnegie, resumed the Sisyphean task.

A non-magnetic ship was built for the ocean magnetic survey: unfortunately this was lost by fire in 1929. Later the British Admiralty built another non-magnetic ship, the *Research*, which should by now have completed its first voyage had war not intervened. We may hope that when peace returns the great work which Halley so well began will be taken up again with his own vigour.

[1] NATURE, 150, 249–257 (1942).

[2] See ref. 22, pp. 203–206; an English version, first published in 1755. is there reproduced with some comments; see pp. 207, 208.

[3] See ref. 22, pp. 203, 87.

[4] English translations of these two poems are given in *Occasional Notes*, No. 9 (1941), of the Royal Astronomical Society.

[5] Mitchell, A. Crichton, *Terr. Mag.*, (*a*) **37**, 105–146 (1932); (*b*) **42**, 241–280 (1937); (*c*) **44**, 77–80 (1939). See also "Geomagnetism", S. Chapman and J. Bartels (Oxford, 1940), chapter 26.

[6] Hellmann, G., (*a*) *Z. Ges. Erdkunde*, **32**, 112–136 (1897) and *Terr. Mag.*, **4**, 73–86 (1899); (*b*) *Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus* (Berlin, 1895–97), Nos. 4, 9, 10; (*c*) "Magnetische Kartographie in historischkritischer Darstellung", *Veröff. Preuss. Met. Inst.*, No. 215 (1909).

[7] Thompson, S. P., "Notes on the *De Magnete* of Dr. William Gilbert", English edition for Gilbert Club (London, 1900).

[8] See refs. 5*b*, § 6; 6*c*, No. 10; 7, p. 11; and *Terr. Mag.*, **48**, 6 (1943).

[9] See "Geomagnetism", S. Chapman and J. Bartels (Oxford, 1940), p. 31.

[10] See refs. 6*a*; 5*b*, § 9.

[11] See refs. 6*a*; 5*b*, § 7.

[12] See ref. 5*b*, §§ 10–25.

[13] Refs. 6*a*; 6*b*, No. 10; also *Terr. Mag.*, **48**, 80 (1943).

[14] Ref. 6*b*; see *Terr. Mag.*, **4**, 80, 86 (1899).

[15] Refs. 6*a*; 6*b*, No. 10; 5*c*; *Terr. Mag.*, **48** (1943).

[16] Refs. 6*b*, No. 10; 5*c* (see Note 5); 7, p. 11.

[17] Ref. 7, pp. 59, 60.

[18] Athanasius Kircher, "Magnes sive de arte magnetica" (2nd ed., 1643), p. 368.

[19] Blundevile, "Theoriques of the Seven Planets" (London, 1602); ref. 7, p. 63.

[20] Ref. 6*b*, No. 9.

[21] Ref. 6*b*, No. 10, chapter 3.

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* Apart from a few additional adjacent pairs of poles, of purely local significance, due to strong local magnetic deposits.

[22] MacPike, E. F., "Correspondence and Papers of Edmond Halley" (Oxford, 1932; London, 1937).

[23] MacPike, E. F., "Hevelius, Flamsteed and Halley" (London, 1937); see also MacPike, E. F., "Dr. Edmond Halley, a Bibliographical Guide" (London: Taylor and Francis, 1939).

[24] Or possibly in 1657; see ref. 23, p. 34.

[25] *Phil. Trans.*, 208 (1683).

[26] *Phil. Trans.*, 563 (1692).

[27] Journal Book of the Royal Society; see *Terr. Mag.*, 18, 118–121 (1913).

[28] See ref. 22, p. 97.

[29] Des Cartes, R., "Principia Philosophiæ" (Amsterdam, 1644).

[30] Bond, Henry, "The Longitude Found" (London, 1676).

[31] Ref. 25, § 9.

[32] Ref. 25; here abridged.

[33] See ref. 22, pp. 135–137; these experiments are discussed in detail by A. C. Williams, "Edmond Halley and the Problems of Terrestrial Magnetism" (London University Dissertation, 1937).

[34] Copies of Yeates' chart are in the British Museum Library (Catalogue No. 974 (2)) and the Admiralty Library.

[35] See ref. 22, p. 186 (Hooke's notes for Jan. 11, 1692/3 and April 12, 1693), also footnote 2.

[36] See ref. 22, pp. 8, 9, 21, 22, 103–115, 243–247, for much interesting information on Halley's magnetic voyages.

[37] See ref. 4.

[38] The method had previously been used by Christopher Burro, who made an isogonic chart mentioned by Kircher (*loc. cit.*, p. 443).

[39] See ref. 22, p. 201, and ref. 23, p. 60.

MORE AND BETTER MILK

IT is common knowledge that while the average diet in most European countries has been seriously worsened by the War (in certain countries it is reported to have been deliberately reduced by the Nazis well below the minimum subsistence-level), the present diet in Great Britain, though drab and much restricted as to choice of food, is still from the point of view of the nutritional scientist little, if at all, inferior to pre-war standards. In fact, as a result of the rationing system and the more even distribution of purchasing power, it is probably true that the great majority of our population is better (or perhaps one ought to say less badly) fed than before the War.

That this is so is due in no small part to the facts that it has been possible (*a*) to maintain the *total* home production of milk at its pre-war level; (*b*) to increase considerably the quantity of *liquid* milk consumed (at the expense of milk which was, in pre-war days, manufactured into products valuable and delectable in themselves but the preparation of which entailed very considerable losses of nutritive value in the shape of whey and skimmed milk, little of which was consumed by the human population); and (*c*) to increase slightly the amount of liquid milk produced in winter when milk is more difficult and economically more costly to produce than in summer. As regards (*b*), during the last three years the yearly liquid milk intake in Britain has risen until it is now about 40 per cent above pre-war level. This is a continuation of a tendency that was clearly evident before the outbreak of war. In 1938, for example, the liquid milk consumption per head in England and Wales rose by 11 per cent.

For the first time in our history a comprehensive Government milk policy, in which the Ministries of Food, Health and Agriculture are collaborating, is now in action, based on the key nutritional importance of milk in the war-time dietary. A number of different but associated schemes have been introduced to implement that policy. They include on the consumption side an extension of the pre-war milk-in-schools scheme, the legislation for giving priority of liquid milk supplies at reduced cost to expectant and nursing mothers and children less than five years of age and to certain classes of invalids, and on the production side the priority given to dairy cows in the animal feeding stuffs rationing scheme, the nation-wide drive through the County War Agricultural Executive Committees to stimulate milk production, the voluntary 'panel' scheme arranged a few months ago between the Ministry of Agriculture, the National Farmers' Union and the National Veterinary Medical Association for the control of certain diseases affecting dairy cows, the national milk testing and advisory scheme to prevent milk souring and to disseminate knowledge of methods of clean milk production on the farm and of hygienic milk handling off the farm, together with national schemes for milk recording and live-stock improvement.

A joint meeting of the Nutrition Society and the Food Group of the Society of Chemical Industry took place at the London School of Hygiene on July 3 to review the nutritional aspects of these and other recent developments and trends in milk policy. The chairman (Prof. H. D. Kay), in his introductory remarks, pointed out that the future of national nutrition is bound up to a great extent with milk production, and that the future of milk production is in a very real way the future of British farming. He emphasized the present difficulties under which milk producers were working, and pointed out the urgent need for improved technical training both for the future dairy farmers and for those entering the technical and scientific side of the milk processing and distribution industry. For the latter entrants there was at present, as before the War, scarcely any advanced vocational training in Great Britain.

The first paper was given by Mr. J. L. Davies, on the production, supply and marketing of milk. He emphasized the enormous size of the milk industry, with a capital estimated (in pre-war values) at £350–£400 millions, and with between 400,000 and 500,000 people actually engaged in milk production, processing and distribution, apart from those in the ancillary industries of feeding stuffs, manufacture and production of dairy machinery, equipment, etc. Of the herds owned by our 150,000 dairy farmers, 36 per cent contained less than 10 cows, 45 per cent 10–25 cows, 15 per cent contained 25–50 cows and only 4 per cent contained more than 50 cows. While the average yield of milk per cow had gone down since the War, he considered that the pre-war average milk yield for the cow in the older established dairying herds was considerably greater than the average for the whole country (which included some herds mainly kept for breeding and rearing purposes), say, 600–650 as against the total country average of 500–550 gallons. There was room for improvement in yield and in methods of milk production, and steps were now being made through W.A.E.C.s to achieve as much as was possible in war-time. Mr. Davies suggested a ten-year plan, to rebuild and re-equip our dairy farms, to bring water supplies and electricity to them, and to render them relatively disease-free. He advocated a six-day (and not, as at present, a seven-day) week on the dairy farm. His ten-year plan would include the steady raising of milk consumption to at least 0·75 pint per head per day accompanied, of course, by the same increase in milk production, which he was sure the industry could provide during the same period. He considered we should plan now.

In the discussion on this paper, Dr. Wooldridge emphasized the importance of disease control on the farm. Disease placed a high and unnecessary tax on the economic cost of milk production. Prof. A. W. Ashby, while supporting the need for greater efficiency in the industry, which could only be achieved by national planning, considered that the economic effect of disease was exaggerated. Dr. Stableforth held the opposite view. Mr. Davies' paper and the discussion which followed took up the whole of the morning session.

In the afternoon, Dr. A. T. R. Mattick dealt with the bacteriological aspects of milk processing. Pasteurization, if properly carried out, both greatly increased the keeping quality of milk and destroyed all the common pathogenic organisms that might occur in raw milk. The difficulty was to ensure that pasteurization *was* properly carried out. For public health reasons there should be filtration of the milk *before* pasteurization. The provisional regulations for the new attractive alternative of high-temperature short-time pasteurization (not less than 162° F. for not less than fifteen seconds) allowed a margin of safety, but the thermometric apparatus controlling flow diversion valves lacked, in some machines, speed of response to changes in temperature. He discussed recent findings on the occurrence in milk of pathogenic and other organisms. Aseptically drawn milk from healthy animals contained only micrococci and Corynebacterium sp., organisms which did not survive ordinary pasteurization. In fact the organisms in cleanly but not aseptically drawn milk were all vulnerable to pasteurization. This was not the case with raw milk reaching the average pasteurization plant, in which heat-resistant organisms were of frequent occurrence. The bacterial quality of raw milk seriously affected the bacterial quality of the milk after pasteurization. Dr. Mattick very much doubted the value of the plate count as a measure of efficient pasteurization. He considered that there was much room for improvement in the design of bottle-filling and bottle-washing machines. With improved methods of production and control on the farm, coupled with improvements in processing technique and particularly in the manipulation of milk after heat treatment, "we have the possibility of furnishing the people with a product of such superb quality as is at present visualized only by the few".

Dr. S. K. Kon followed with a paper on the chemical composition and nutritive value of milk and milk products. This paper gave a wealth of recent quantitative findings impossible to summarize in a review. Milk varied in chemical composition and nutritive value not only with the breed and health of the cow, but in the same healthy cow from one season of the year to another. The diet of the cow was largely responsible for changes in the vitamin A content of milk and to a lesser extent for the changes in riboflavin; but vitamin B_1, which was synthesized in the bovine rumen, was fairly constant in quantity throughout the year. Vitamin C was synthesized by the cow, but unlike the B vitamins the synthesis did not take place in the rumen. It was unfortunate that milk was lowest in vitamin content in early spring, since most other human foodstuffs were at that season at their nadir of nutritional value. He considered that more attention should be paid in future to nutritive quality of milk produced in Great Britain.

The effect on the nutritive value of milk of pasteurization, sterilization, drying and condensing was stated in some detail by Dr. Kon. Commercial pasteurization brought about a loss of vitamin C of the order of 20 per cent, caused rather by exposure of the milk to light than to heat, and a still smaller percentage loss of vitamin B_1 but no other change of nutritional significance. The effect of sterilization was rather larger—a loss of half the vitamin C and one third of the vitamin B_1. There is, in any event, little vitamin C in cow's milk, and not very much D. But even the small quantity of vitamin C in a pint bottle of raw milk was halved if the bottle was left on the doorstep in full daylight for half an hour; destruction was still more rapid in sunlight. Spray drying of milk led to a very small loss in nutritive value, of the same order as that caused by pasteurization. Roller drying brought about rather larger losses. Vitamin A and carotene, vitamin D and riboflavin suffered no loss during drying. Among other important points Dr. Kon emphasized the nutritional importance of the by-product from butter manufacture—skim milk. Dried skim milk ('National Household Milk') was an excellent food for all ages except early infancy.

The discussion on these two papers was opened by Prof. G. S. Wilson, who stressed the great difficulty that responsible medical men had in advocating the increased consumption of milk unless the latter had previously been efficiently pasteurized. He dealt with the human diseases that might be conveyed by raw milk, and exploded several of the arguments brought forward by the opponents of compulsory heat-treatment of milk. A lively discussion followed, in which Mr. A. L. Bacharach, Dr. H. E. Magee, Dr. N. S. Barron, Dr. W. A. Lethem, Captain H. Barkworth, Prof. J. R. Marrack, Dr. Kent-Jones and others took part. Perhaps too much attention was paid in the discussion to the pasteurization problem—the major facts concerning which are well known. In consequence, some of the important bacteriological and nutritional points made by the principal speakers in the afternoon session were crowded out.

In summing up, Prof. Kay stated that the real war-time problem was to get to every consumer the maximum quantity of safe winter milk, and he emphasized the great contribution that dairy farmers and those advising them and directing their efforts had made in maintaining the national winter milk supply during the War. There seemed to be no dissentients in this representative meeting of nutritionists (nearly three hundred were present during the afternoon session) to the view that general heat treatment of milk was highly desirable, in fact overdue, and that not least from the point of view of the true interests of the producer. It was also clear that the meeting fully agreed with the importance of increased consumption of liquid milk, and that the objective should be an average of not less than 1 pint per head per day. There was general agreement that one of the questions of greatest moment at present from the point of view of national nutrition was how the trend, clearly evidenced during the War, towards increased *per capita* milk consumption was to be maintained in the post-war period until this objective was achieved. Planning for increased post-war production and consumption should begin forthwith. There were three sides at least to this question, the producer's, the distributor's and the consumer's, and better technical training for all three, not excluding the frequently forgotten consumer, was urgently needed if this problem were to be solved in a reasonable time.

SOME CZECHOSLOVAK CONTRIBUTIONS TO CHEMISTRY IN THE NINETEENTH CENTURY

By DR. GERALD DRUCE

THE modern development of chemistry in Bohemia may be considered to have passed through five phases. These are: (1) an initial era closely associated with the Czech national revival movement and mainly concerned with descriptions and analyses of local natural resources; (2) advancement in teaching contemporary science; (3) improvement in analytical technique and corresponding progress in methods of research; (4) the period of Brauner's atomic-weight determinations and researches on the rare earths; and (5) varied research activities between 1918 and 1938.

The latter part of the fourth phase and the whole of the last one, when Czechoslovak chemists made some notable advances, fall outside the scope of the present survey. Similarly, the beginnings of the national revival (in which men of science played a leading part) date back to 1790, or perhaps to 1780, so that only the later, but scientifically more exact, work of the naturalists and chemists of this period will receive notice here.

The establishment of the Bohemian National Museum and the "Museum Society" in 1818 gave an impetus to the study of the sciences. Among the collections of local minerals presented to the Museum were specimens of unknown composition awaiting examination. There were also many economic native and exotic plants in the new herbarium, which soon included many thousands of specimens. Lastly, the medicinal qualities of the thermal and spa waters were then attracting attention and trustworthy analyses were urgently needed.

A typical mineral study was that of J. S. Presl on pribramite, a hydrated silicate of iron containing manganese and magnesium[1]. Many of these mineral analyses were made by men who were primarily geologists, like Prof. F. M. Zippe. Some of the Bohemian aristocracy were also interested in the natural sciences. In 1831, Count B. W. Berchtold analysed the efflorescence observed on bricks and known as "air salt" and referred to in his memoir as "Bruska salt" after the Prague suburb where it was collected[2].

In 1819, J. J. Steinmann prepared strychnine and isolated morphine[3], and a newly formed "Patriotic Economic Association" allocated funds for extracting it from poppies. The same body had also entrusted Prof. Mikan with the task of 'de-sulphurizing' coal. Presl and Steinmann (then professor of chemistry at the University of Prague) examined Kysibl Spa water[4], which later became a famous table water; Dr. A. Jungmann gave a comprehensive account of many other thermal waters[5]. When Berzelius visited Carlsbad in 1831 he examined the gas from the hot springs and estimated that it contained 1 per cent of nitrogen; it is mainly carbon dioxide, but is now known to contain about 1 per cent of inert gases, including radon.

There was a lack of laboratory facilities in Prague during the first quarter of the century and the few Czech chemists of note had little chance of making their work known except through German publications. Their only publications were the proceedings of the Bohemian Scientific Society (founded in 1775), a quarterly publication issued by the Museum, and Presl's periodical, *Krok*, which appeared at irregular intervals between 1821 and 1840. Though primarily a biologist, Presl devised a scheme of dry tests for the qualitative detection of metals, but it was not widely used. He wrote the first Czech text-book of chemistry, the inorganic part appearing in 1828 and the organic part in 1836[6]. It was a useful pioneer treatise that was superseded after 1841 by Prof. Amerling's[7]. This book, which recognized fifty-six elements, traced the development of crystallography and touched upon biochemistry. Thus, Amerling pointed to the constant occurrence of certain metals (potassium, calcium, magnesium and iron) and other elements (chlorine and sulphur) in plants and animals. He also appreciated the value of Faraday's work, and in surveying earlier developments he emphasized the importance of Black's discoveries with the alkaline earth carbonates.

These text-books gave Czech students a knowledge of chemistry in their own tongue. Previous lecturers like Mikan, Freysmuth, Neumann (Brauner's grandfather and author of a German "Lehrbuch der Chemie", 1810) and Balling (who studied both fermentation and metallurgy) had used German works. Noteworthy among these students was B. B. Quadrat, who, in 1844, investigated the double platinum cyanides[8] and prepared phenyl thiocyanate and studied its reactions and decomposition products[9]. Further contributions to organic chemistry were made at this time by Prof. J. Lerch, who isolated a number of monobasic acids (caproic, caprylic, capric, etc.) from various animal fats[10]. He also tried to elucidate the nature of the explosive, potassium carbonyl, sometimes formed during the preparation of potassium by dry distillation of the tartrate.

The outstanding figure of the third era of Czech chemistry was František Štolba (1839–1910), professor of chemistry at the Prague Polytechnic. He has been styled "the Czech Bunsen" on account of his influence and his extensive researches, though these never reached the magnitude or importance of those of the German chemist. From 1865 onwards Štolba published several hundred original papers, most of which were abstracted for the *Journal of the Chemical Society*, while the *Chemical News* referred to more than fifty of them. In 1877 Štolba founded the *Chemické Listy*, thus giving Czechoslovak chemists the opportunity to announce their discoveries in their own language.

In Štolba's first communication he demonstrated that both water and hydrochloric acid have an appreciable action on lead[11]. He proceeded to many analyses of local interest. Thus, he showed that the organic matter in water from Bohemian rivers was related to its calcium content. Another observation typical of the man was that platinum vessels lost in weight when heated in coal gas flames, though polished platinum lost less than unpolished. This was borne in mind later by Brauner, who not only kept his platinum ware highly polished but also always heated it inside another vessel. Štolba was one of the first to extract indium from zinc blende and tellurium from lead chamber mud, while another observation related to the identity of potassium chlorate crystals obtained either by fusion or by crystallization from aqueous solution. But his most important contribution to chemistry was his researches in the silico-fluorides.

Štolba prepared quantities of hydrofluoric and hydrofluosilicic acids and showed that the latter dissolve metals, for example, iron, evolving hydrogen. With this acid he made silicofluorides of cerium (from its acetate), cobalt (from the carbonate), ammonium (from the iron salt and ammonium chloride) and calcium (by heating together fluorspar, infusorial earth and hydrochloric acid). Štolba also noticed that beads of potassium silicofluoride heated in a blowpipe flame on platinum lost silicon fluoride and left a mixture of potassium fluoride and silicate. Curiously enough, Štolba's method for the analysis of silicate minerals began with sodium carbonate fusion, followed by re-fusion under salt. He left it to his colleague, the mineralogist Prof. E. Bořický, to 'open up' these minerals with hydrofluoric acid.

No account of Štolba's work would be complete without reference to his monograph advocating wider laboratory use of nickel. He emphasized its suitability for making crucibles, spatulas, tweezers, etc., and he indicated the precautions to be observed. He was also alive to the possibilities of aluminium, which was just becoming available in the 'eighties.

Among other noteworthy chemical discoveries made by Czech chemists in the middle of the last century are those of Prof. Karel Preis, lecturer at Prague Polytechnic and later founder of the Sugar Research Institute. Before devoting himself to technological researches he studied the action of iodine on unsaturated organic compounds, made the bromides of tin and some double salts in a pure state and came across a curious double sulphide of iron and potassium[12]. With Dr. B. Rayman he oxidized cholesterol and some derivatives with nitric acid. That more Czechs did not interest themselves in organic chemistry at this time is difficult to explain. Prof. A. Bělohoubek, contemporary with Štolba, showed that pure methyl alcohol never gave chloroform with bleaching powder. From a comprehensive survey of organic compounds he concluded that the richer these are in oxygen the more soluble they are, while liquids are mutually soluble the more similar their structure.

During the last quarter of the century Czech inorganic chemists made good progress. It was dominated by the work of Brauner and his collaborators, which overshadowed the less spectacular but still important contributions made by Wald and Stoklasa.

Prof. F. Wald was a physical chemist who maintained that stoichiometrical laws are deducible without recourse to any atomic hypothesis. In 1887, independently of J. W. Gibbs, he propounded a theory of phases on the basis that all substances that mix continuously and homogeneously constitute a single phase. Therefore, gases exist as one phase only, since two or more gases or vapours never form sharp boundaries. Liquid phases are more numerous, while with solids it is still more difficult to characterize one or more phases. It would be difficult to summarize Wald's views in a few lines[13], but his definition of an element may be taken as typical:

"Amongst chemical individuals there is a group of substances which possess a remarkable property. From them may be prepared by chemical reactions other pure substances, yet they are never alone a product of other reactions. Such bodies are called elements. If reactions which are described in a three-membered equation did not exist, elements would remain unknown to us; no substance of a reaction, in which a certain number of reactants gives the same number of resultants, can be regarded as a part of the others. Our knowledge as to the number of elements remains, however, provisional as we have no guarantee that the substances now regarded as elements will not be shown to be decomposable and interchangeable."

Ostwald, in his Faraday Lecture in 1904, referred to Wald's views in the following words:

"The question whether it is possible to deduce the stoichiometrical laws without the help of the atomic hypothesis has only been raised by other investigators in order to deny the possibility. So far as I am aware there exists only one man (Wald) who has worked on the question with the earnest hope of obtaining an affirmative answer . . . to him I owe first the idea that the definition of substances and elements is in a certain sense arbitrary, although very helpful and convenient. This definition is a condensed expression of our methods of separating and purifying these bodies. While, generally speaking, every solution has the same claim to be investigated as these bodies, the latter soon distinguish themselves as standards to which all other cases may be referred. To Wald I owe further the idea that the conception of a phase is a far more general one than that of a substance, and that the deduction of the laws governing the nature of substances must start from the conception of a phase. . . ."[14]

Stoklasa's researches were partly analytical and partly biochemical. Among other matters he showed that both iron and phosphorus are essential elements for the formation of chlorophyll in plants. In his lengthy study of lecithin he found that it decomposes in the absence of phosphates and that plants lacking phosphates retrogress for this reason.

Brauner's work, lengthy and important though it was, can only receive very brief notice here. It began in 1877 with his observations on beryllium and had for its main object the substantiation of Mendeléeff's Periodic Law[15], the great value of which Brauner was one of the first to appreciate. Most of his atomic weight determinations and his separations of the rare earth elements were made before 1900, and indeed Mendeléeff stressed their importance so early as 1889 in his Faraday Lecture[16]:

"The Periodic Law, as Brauner repeatedly insisted, was against the formula, Be_2O_3. It required the formula BeO, *i.e.* an atomic weight of 9. . . . I consider the confirmation of Brauner's view as important in the history of the law as the discovery of scandium."

Science is international in its ramifications, and the discoveries of savants of one nation influence and inspire the work of others in distant lands. Not only did Brauner make contact with Russian men of science, but he also established connexions with British and American chemists; and at the close of the nineteenth century many young Czech chemists, beginning their careers, spent part of their student or post-graduate years abroad. At this time, Štěrba-Böhm was collaborating with Brauner in further studies of the rare earths, while Votoček had begun his life-work on the less common sugars. After closely studying arabinose he examined rhodeose, a methylpentose that he had isolated from the glycoside convolvulin[17].

In chemistry, as in other sciences, Czechoslovaks made notable advances during the nineteenth century. This work continued to expand and extend until 1939, and when they are able to resume their work for the progress of mankind it can be confidently predicted that they will contribute again to the advancement of chemistry.

[1] *Krok*, **2**, 63 (1824).

[2] *Krok*, **2**, 616 (1824).

[3] *Schweigg, J.*, **25**, 410 (1819).

[4] *Casopis Ceského Musea*, **5**, 297 (1831).

[5] *Casopis Ceského Musea*, **5**, 80 (1931).

[6] "Lučba čili Chemie Zkusná" (Prague, 1828 and 1836).

[7] "Prehled Lúčby čili Hmotozpytu" (Prague. 1841).

[8] *Casopis Ceského Musea*, **22**, 143 (1848). *Ann.*, **63**, 164 (1847); **65**, 249 (1848).

[9] *Ann.*, **71**, 13 (1849).

[10] *Ann.*, **48**, 221 and **49**, 212 (1844); **59**, 57 (1846).

[11] *Chem. News*, **11**, 226 (1865). The General Index to the first 100 volumes of the *Chemical News*, and the Decennial Indexes of the *Journal of the Chemical Society* give many references to Štolba's papers and to those of other Czech researchers.

[12] *Chem. News*, **20**, 70 (1869); **36**, 90 (1877) and **50**, 104 (1885).

[13] An account in English of Wald's theory is given in *Collection*, **3**, 9 (1931).

[14] *J. Chem. Soc.*, **85**, 506 (1904).

[15] See NATURE, **150**, 632 (1942).

[16] *J. Chem. Soc.*, **55**, 634 (1889).

[17] *Vestnik Král. Cesk. Spol. Nauk.* (1899).

OBITUARIES

Dr. C. J. S. Thompson, M.B.E.

DR. C. J. S. THOMPSON, who died recently, was born at Liverpool in 1862. As a young man he studied chemistry and pharmacy and became interested in the historical aspect of these subjects. In 1898 his close association with what was ultimately to become the Wellcome Historical Medical Museum commenced. From this date he played an active part in assisting Sir Henry Wellcome in the work of collecting, classifying and assembling the ever-increasing store of material. In 1913, he became the first conservator of the Wellcome Historical Medical Museum.

Thompson travelled widely and was a successful collector: he was much interested in the literature of his subject, and played an important part in establishing the large research library attached to the Museum. In the International Congresses of the History of Medicine he played a prominent part, more especially in the Congress held in London in 1922. He was a prolific writer with a wide knowledge of his subject, a ready pen and a popular style. He covered a large field in his numerous articles and books, many of which were popular in character and dealt with such subjects as alchemy, crime, quackery, apparitions, monsters, magic and love. He also compiled in collaboration with Sir D'Arcy Power a most useful "Chronologia Medica".

His connexion with the Wellcome Museum terminated in 1926, and in the following year he was elected honorary curator of the Historical Collection of the Royal College of Surgeons. His "History and Evolution of Surgical Instruments", published in the United States in 1942, was opportune, for in May 1941 much of the collection had been destroyed by enemy action.

During the War of 1914–18 he was in charge of an auxiliary military hospital at Harrow, for which work he was awarded the M.B.E.

Thompson was a great enthusiast, an indefatigable worker, and a good organizer. For such a man retirement is merely the opportunity for further work and, to the end, he was busily occupied with the subject which he had made so peculiarly his own. He did much to popularize a branch of medicine which in Great Britain has never received the recognition it deserves. S. H. DAUKES.

Dr. R. W. Gray.

ROBERT WALKER GRAY, born at Peterhead, Aberdeenshire, in 1864, came of whaling stock. His grandfather and his father were well-known skippers in the Peterhead whaling fleet, and the latter, doubtless inspired by the example of the Scoresbys, made many records of his observations in the Arctic seas. David Gray's "Notes on the Greenland Whale" appeared in annual reports of the Scottish Fishery Board and elsewhere, accounts of the year's whaling in the *Buchan Observer*, and Southwell made use of some of his information in his articles on sealing and whaling. It was natural, therefore, that one of the sustained interests of the son, R. W. Gray, should be in whales and whaling. His name appears in the roll-book of the natural history class at the University of Edinburgh for the session 1887–88, when he was in his twenty-third year, and he graduated in medicine at that University in 1892. Having already made several voyages to the Greenland Sea, he became surgeon upon his father's whaler, *Eclipse*, at a time when the Peterhead whaling was all but extinguished, and his subsequent experience included voyages with the Orient Line as medical officer, the study of sleeping sickness in Africa, and a long period of general practice in towns on the south coast of England.

Since his earliest accounts of voyages to the Greenland Sea appeared in the *Zoologist* in 1887 and 1889, Dr. Gray continued to publish articles bearing upon the history of the whale-fishery and on whales and their habits. He contributed the account of "Whale Fisheries" to the ninth edition of the "Encyclopædia Britannica", and his description of the rise and decline of the "Peterhead Sealers and Whalers" in the *Scottish Naturalist* of 1932 and 1933 was a valuable contribution to the history of the whaling industry. Dr. Gray's knowledge of the literature of whaling was thorough, and he made good use of it and of his own experiences in discussing, in the *Naturalist* and in occasional letters to NATURE, debated points concerning the physiology of whales.

Dr. Gray had a quiet unassuming manner and a mind richly stored with memories of his adventures in the Greenland Sea and Davis Straits. Having retired from medical practice, he died early in July in Exeter, after a short period of failing health, in his seventy-ninth year. JAMES RITCHIE.

WE regret to announce the following deaths:

Dr. H. C. Bumpus, director of the American Museum of Natural History, New York, during 1902–11, on June 21, aged eighty-one.

Mr. F. J. Cleminson, honorary director of research, Ferens Institute of Oto-laryngology, Middlesex Hospital Medical School, on August 21, aged sixty-five.

Mr. Arthur S. Newman, the well-known camera designer and photographic expert, on August 12, aged eighty-two.

Prof. F. Schlesinger, emeritus professor of astronomy in Yale University, on July 10, aged seventy-two.

NEWS AND VIEWS

Carnegie United Kingdom Trust

The twenty-ninth annual report of the Carnegie United Kingdom Trust covering the year 1942 shows that the operations of the Trust have been more concerned with the development or the completion of old schemes than with the initiation of new ones. In regard to youth services, the system of club equipment grants has been continued in England, Wales and Scotland, and has also been extended to Northern Ireland. The year's payments amount to £5,695 and substantial sums are still outstanding in respect of promises not yet taken up in full; the 1942 promises at December 31 stood at £12,168. Shortage of equipment due to the supplies situation and the scarcity of trained leaders are likely to present serious difficulties to any large expansion of the youth services at present. The limited revival of the former club library policy has met with very encouraging responses, and grants in aid of the headquarters administration of the national associations of boys' clubs, girls' clubs and young farmers' clubs were maintained in 1942 at the same rate as in the previous year. Notice of the discontinuance of these grants has now been given, but further assistance has been promised to the Eighteen Plus movement during the three years 1943–45. Grants for the training of leaders, of £1,200 to the National Association of Girls' Clubs for local supervisors of training and £1,000 for bursaries, were continued from 1941. Grants were also made during 1942 in aid of the administration of the Land Settlement Association, the Museums Association, the National Council of Social Service and the Rural Development Council of Northern Ireland, and towards the maintenance of the three central libraries. In regard to music and drama, the work of the Musical Education Committee has continued on the same plan as in 1941 but on a larger scale. The work of the Joint Committee for Drama also showed an increase in expenditure, and the report comments on the remarkable way in which musical and dramatic activities are not merely surviving the War but even extending and fortifying themselves.

Utilization Investigations of Forest Products

As during the War of 1914–18 so in the present War, the utilization of forest products has assumed a first-class importance in India. During the War of 1914–18 the exports from the Indian forests, mainly timber and forage, went chiefly to the Middle East. But India herself had to become self-supporting in several commodities such as, for example, soap, matches, bobbins for weaving and even to a greater extent railway sleepers, when these products could no longer reach her by import. This state of affairs has repeated itself during the present War, but has become more exacting through the greater demand on India to provide war supplies for her own needs and including those of a rapidly expanding modern army. This position fully explains the reason for the inevitable expansion of the work of the Utilization Branch of the Dehra Dun Forest Research Institute. Research on timber-seasoning kilns has already been dealt with (see Nature, July 25, 1942, p. 127). Indian Forest Leaflet No. 34, Utilization (1943), "Types of Timber Seasoning Kilns suitable for drying Indian Woods", revises Leaflet No. 11, issued on the subject. Leaflet No. 33 (1943) deals with the detailed design of timber roof trusses made with disk dowel joints. Timber structures fitted in this fashion have not previously been used in India. The data incorporated in the leaflet are the result of actual tests carried out in the laboratories of the Institute.

Indian Forest Bulletins, Utilization, Nos. 114 and 117 (1943) discuss the "Treatment of Green Hollong (*Dipterocarpus macrocarpus*) Sleepers" and the "Testing of and Improvement in Design of Packing Cases". The green hollong sleepers were treated with a mixture of creosote and fuel oil; by conditioning the sleepers by steaming and vacuum or the Boulton process, or a combination of both, they could be satisfactorily treated, on an average 30 per cent moisture being lost. The packing case investigation was carried out at the instance of the Ordnance Stores Department. Cases for packing medical stores were the ones to which the investigation was confined. Three types of cases were examined, and the improvements proposed are discussed in the bulletin.

Our Knowledge of the Physical World

Dr. A. C. Ewing, in an article entitled "Knowledge of Physical Objects", has discussed the question, "How can we justify the claim to know the physical world?" (*Mind*, April 1943). He first considers the contention that it is meaningless to entertain a *general* doubt about such knowledge because there are no possible experiences which could cast doubt on *all* physical propositions, only on some. He answers it by pointing out that dreams and illusions are the experiences on which the general doubt is based, and even though they are not conclusive evidence, the doubt has meaning by reference to them. This was a point well worth making. He next examines Prof. Moore's view that we can know with certainty something which it is both logically possible might not be true and also logically possible we might be wrong in thinking we knew. Our knowledge of physical objects is of this kind, according to Moore, and we know them without knowing how we know them. As Moore does not hold that we know physical objects directly, it seems possible to raise a doubt about our knowledge by pointing out that induction, by means of which this knowledge is established, cannot yield certainty. Briefly, Moore's answer to this is that the proposition that inductive argument cannot yield certainty is itself *less* certain than the proposition that he knows there is a chair.

The author develops his own position from this point by urging that strictly we can only speak of knowing that *S* is *P* where "*S* is *P*" is *objectively* as well as subjectively certain; but that we commonly say we 'know' that *S* is *P* where we are practically certain, though error is theoretically possible. In the strict sense we do not know that there are physical objects; in the other sense we do. Such knowledge is based on induction and therefore it must be admitted that any particular proposition which we know can by further evidence be rendered more certain than it is at any particular time. This is the Achilles' heel of the author's view. The present writer cannot believe that the existence of the table on which he wrote these notes, and on which a short time ago his supper was laid, can be rendered more certain. The distinction drawn by Dr. Ewing does not solve the problem. It simply takes us back to the discarded view that the existence of physical objects cannot be known, though it can be rendered highly probable.

Vital Statistics of Scotland

According to the quarterly return of the Registrar-General of Scotland, 1942 was a very healthy year, as is shown by the fact that the death-rate from all causes was 13·0 per 1,000 of the population, or 1·5 below the corresponding rate for 1941 and 0·7 below the average for the quinquennium 1936–41. The birth-rate was 18·1 per 1,000, or 0·2 above the average for 1941 and 0·5 above the five-year period. Both infantile mortality and maternal mortality showed very satisfactory rates, the former being 69 per 1,000 live births and the latter 4·0 per 1,000 total births, which was the lowest rate on record for about four decades. The deaths from the principal epidemic diseases were the lowest on record, amounting to 1,060. As regards the chief chronic diseases with a high mortality, the death-rate from all forms of tuberculosis was 80 per 100,000. Though there was a decline in non-respiratory tuberculosis, especially in the age-group fifteen to twenty-five, there was a definite rise in the respiratory tuberculosis death-rate. Increase in the death-rate for syphilis was shown mainly by an increase in aneurysm and congenital syphilis. The death-rate from malignant disease was 171 per 100,000, which represented an increase above the 1941 rate. On the other hand, there was a definite decline in the death-rate for cardiac and respiratory diseases apart from tuberculosis and malignant disease.

Syphilis in the United States

In a recent paper (*J. Amer. Med. Assoc.*, **122**, 365; 1943) Dr. W. G. Smillie maintains that the incidence of syphilis among white men in the greater part of the United States is low, and that it is limited for the most part to the lowest classes of society, so that it has become a disease largely of the ignorant, the careless, the criminal and the social outcast. Syphilis, however, is more than ten times as prevalent among the Negroes as among white persons. In recent examinations for army service, the incidence of syphilis among whites was 0·2 per cent, as compared with 11·2 per cent among Negroes.

Tuberculosis in Buenos Aires

According to Dr. Alejandro A. Raimondi (*J. Amer. Med. Assoc.*, **208**, 121; 1943), director of the Municipal Centre of Buenos Aires for a Campaign against Tuberculosis, there were 2,708 deaths from that disease in Buenos Aires in 1941. The increase in the disease is due to the influx of tuberculous subjects from the provinces. The routine practice of taking skiagrams of children has resulted in finding tuberculosis where it was not suspected and also in preventing the spread of the disease. X-ray examination of the chest of apparently normal persons has yielded good results. Tuberculosis has been found in only five cases (1·3 per cent) in a group of 384 students and in only twenty-five cases (3·02 per cent) in 826 applicants for municipal posts.

Agricultural Research Council Appointments

The Committee of the Privy Council for Agricultural Research has appointed the Right Hon. the Earl De La Warr to be chairman of the Agricultural Research Council in succession to the late Sir Thomas Middleton. The Committee has further appointed Prof. I. de Burgh Daly to be a member of the Agricultural Research Council in succession to Sir Joseph Barcroft, whose term of office as a member has expired.

Library Stocks of Periodicals

Referring to the letter on "Library Stocks of Periodicals" published in Nature of July 24, Mr. C. C. Barnard writes: "I inadvertently failed to appreciate the proposals of a committee of the Association of Special Libraries and Information Bureaux, which has under consideration the preparation of a Union Catalogue of Periodicals in British Libraries. This Committee proposes at present to limit its plan to the compilation of a consolidated check list composed of entries in the 'World List of Scientific Periodicals', the 'Union Catalogue of Periodical Publications in University Libraries', and the relevant section of the 'British Museum Catalogue'. The work which it contemplates should be of assistance in the accomplishment of the larger scheme which I outlined."

Wellcome Junior Fellowship

The Joint Advisory Committee of the Wellcome Foundation and the Veterinary Educational Trust has awarded the first Wellcome Junior Fellowship to Mr. John Lochiel McGirr. The fellowship is tenable for one year at £400 per annum and is subject to renewal for a further period of one or two years at the discretion of the Advisory Committee. Another fellowship of equal value will be awarded in April 1944. The award to Mr. McGirr represents the first result of the recent foundation of the Veterinary Educational Trust.

The Night Sky in September

Full moon occurs on September 14d. 03h. 40m. U.T. and new moon on September 29d. 11h. 29m. The following conjunctions with the moon take place: Sept. 2d. 00h., Mercury 7° S.; Sept. 20d. 03h., Mars 4° N.; Sept. 21d. 05h., Saturn 3° N.; Sept. 25d. 14h., Jupiter 0·3° N.; Sept. 26d. 16h., Venus 8° S. The following occultations of stars brighter than magnitude 6 take place: Sept. 8d. 21h. 02.4m., 15 Sgr (*D*); Sept. 10d. 21h. 27.3m., σ Cap (*D*); Sept. 26d. 11h. 08.2m., α Leo (*D*); Sept. 26d. 12h. 12.1m., α Leo (*R*). The times are given for Greenwich and *D* and *R* refer to disappearance and reappearance respectively. Mercury, an evening star at the beginning of the month, sets a quarter of an hour after the sun on Sept. 1. The planet is approaching the sun and is in inferior conjunction on Sept. 24. Venus is in inferior conjunction with the sun on Sept. 6. At the middle and end of the month the planet can be seen as a morning star, rising at 4h. 43m. and 3h. 20m. respectively. Mars, in the constellation of Taurus, is an evening star and sets at 13h. 20m., 13h. and 12h. 32m. at the beginning, middle and end of the month respectively. Jupiter is a morning star, rising at 3h. at the beginning and 1h. 33m. at the end of the month. Saturn, in the constellation of Taurus, is a morning star, rising at 22h. 08m. in the middle of the month. Times are given approximately for the latitude of Greenwich. The Autumn Equinox commences on Sept. 23d. 22h. The longer evenings provide opportunities for those who are interested in observational work, and many interesting objects are within the range of a small telescope.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

X-Irradiation of Rabbit Spermatozoa *in vitro*

The classic experiments of Hertwig on the X-irradiation of frog spermatozoa were recently extended by Rugh[1], who reported that exposure of the spermatozoa to doses from 15 r. to 10,000 r. caused a progressive increase in embryonic mortality; at the higher dosage only 1·6 per cent of the embryos hatched. Further increase of the dosage, however, increased the number of viable embryos; at 50,000 r., 90·5 per cent hatched. These embryos were morphologically uniform and very similar to haploids produced by other means. Rugh concluded that with the higher doses the spermatozoa, which showed normal motility, were able to penetrate the egg, but were unable to effect syngamy, so that the development initiated was parthenogenetic.

Comparable effects with the small doses have been demonstrated in mammals. Doses of 800 r. to mice[2] and 1,000 r. to rats[3] do not diminish the capacity of the existing spermatozoa to effect fertilization, but early mortality among the embryos reduces litter size. The mammalian work on X-rays, with the solitary exception, so far as we know, of some inconclusive experiments by Asdell and Warren[4], has involved the mating of irradiated males, a technique which has several disadvantages. Pincus and Enzmann[5], however, carried out a few experiments on rabbits by inserting into the Fallopian tube spermatozoa which had been exposed *in vitro* to ultra-violet irradiation, and obtained some rather inconclusive evidence of penetration and activation of the eggs without syngamy. We have now carried out, also on rabbits, experiments involving the *in vitro* X-irradiation of semen, followed by artificial insemination. In addition, the induction of superovulation by the injection of gonadotrophin has proved most useful in augmenting the number of eggs used for the study of the segmentation stages.

The females were killed and the tubal or uterine contents examined at various times up to 40 hr., at 9 days, or at 28 days after ovulation. Results with the various dosages were briefly as follows:

50 *r. and* 100 *r.* The great majority of the eggs segmented normally and normal implantations at 9 days and normal young at term were also obtained.

250 *r. and* 500 *r.* Most of the eggs were segmenting normally at 40 hr., but there was a definite increase in the percentage of those which were retarded or arrested. Normal implantations and apparently normal young at birth were obtained, but in small numbers.

1,000 *r.* The great majority of the eggs had started to divide but had no more than 10 cells at 40 hr.; less than 3 per cent were apparently normal. No implantations at 9 days or young at term were obtained with this or any higher dose.

2,500 *r.*–10,000 *r.* More than 70 per cent of the eggs recovered at 40 hr. had started to segment, but most of these were in the 3- or 4-cell stage. None was segmenting normally.

25,000 *r.*–50,000 *r.* Most of the eggs had made a single division only at 40 hr., and were arrested in the 2-cell stage.

100,000 *r.* Only 8 of the 70 eggs obtained at 40 hr. had divided, and 6 of these were in the 2-cell stage.

Cytological examination was made of many of the eggs fertilized by spermatozoa receiving between 500 r. and 100,000 r. The presence of male nuclei within the cytoplasm of the egg showed that penetration had been effected at all dosages. Spermatozoa were abundant in the perivitelline space and zona pellucida at all dosages up to 50,000 r., but at 100,000 r. very few were seen. Delay in migration and vesiculation of the male nucleus was observed at all doses from 1,000 r. to 10,000 r. and constituted the earliest indication of any organic change caused by irradiation of the spermatozoa. Cytological evidence of damage to the male nucleus appeared only with doses of 10,000 r. and above. At lower doses the nuclei were single and oval or spherical, while with the higher doses the majority were hypertrophied and lobed.

At the stage of fusion of the pronuclei the effects of various dosages may be summarized as follows:

1,000 *r.* Syngamy was complete with no outward sign of irregularity in the male pronucleus.

10,000 *r.* Syngamy took place, but the male pronucleus was very irregular and hypertrophied, and the chromosomes remained dispersed.

25,000 *r.* Syngamy might take place, but in some eggs the occurrence of polyspermy produced derangement in the distribution of the chromosomes. Cytoplasmic division and separation in these cells might be incomplete.

50,000 *r.* Syngamy occurred, but the formation of the male chromosomes was delayed or suppressed, so that zygotic combination was weakened. Because of the delay in polar migration of the chromosomes the cleavage spindles were irregular.

100,000 *r.* Extrusion of the polar bodies and migration of the male nucleus was observed, but no syngamy in any of the eggs studied. However, the recovery of 2-celled eggs with diploid chromosomes showed that the absence of syngamy may not be constant. The occurrence in one egg of a single segmentation spindle with haploid chromosomes suggested that spermatozoa exposed to 100,000 r can sometimes activate the egg without fusion of the pronuclei. No evidence of continued gynogenetic development was, however, obtained.

A full account of the experiments outlined above is being prepared, but it may be noted here that the technique of semen collection, artificial insemination and, where appropriate, induction of superovulation offers exceptional facilities for the type of work described above, and is being used by us for the study of the effects of chemical and serological as well as of physical agents on the physiological and genetic properties of mammalian sperm.

We are much indebted to Dr. W. V. Mayneord who kindly allowed the irradiations to be carried out in the Department of Physics of the Royal Cancer Hospital.

E. C. Amoroso.

Histology Department,
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A. S. Parkes.

National Institute for
Medical Research, N.W.3.
July 26.

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[3] Henson, M., *J. Exp. Zool.*, 91, 405 (1942).

[4] Asdell, S. A., and Warren, S. L., *Amer. J. Rönt. and Rad. Therap* 25, 81 (1931).

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Possible Role of Birds in the Maintenance of Yellow Fever in West Africa

In 1936 it was shown that the blood of monkeys from endemic yellow fever zones in Africa contained immune bodies to the yellow fever virus, as judged by the intraperitoneal mouse protection test: the sera of monkeys outside the endemic zone did not contain immune bodies[1]. These results have since been confirmed by other workers. At the same time, the blood of a sheep from the Gambia was found to possess virucidal bodies against the yellow fever virus. Since then virucidal bodies have been found in the blood of cattle, sheep, dogs, pigs and a camel: the significance of these findings in domestic animals awaits further study, since virucidal bodies were present in the blood of certain domestic animals living outside the commonly accepted yellow fever zone.

Although there is highly suggestive evidence that monkeys may act as an alternative host to man in maintaining yellow fever in Africa, the monkey population is not large, nor is there evidence that monkeys migrate over great distances.

A search has therefore been made for other possible hosts sufficiently numerous to maintain the virus in the absence of man. The sera of a number of animals and birds have been examined from the Gold Coast. Although no epidemic has been reported in this Colony since 1937, single sporadic cases have occurred every year, and immunity surveys in children show that the number of cases reported bears no relation to the number of children giving positive results. Apart from monkey sera giving positive results, a rodent, a Cutting grass *Thryonomys swinderianus*, one of five examined, has been found to possess virucidal bodies to yellow fever virus in its blood. The sera of civet cats, giant rats, bush-tailed porcupines and royal pythons have been negative. More striking results have been obtained with the sera of wild birds. Of forty birds examined four have shown virucidal bodies to the yellow fever virus. The positive birds were a buff-backed heron *Bubulcus ibis ibis*, one of four examined, an African barn-owl *Tyto alba affinis*, one of three examined, and a Senegal kingfisher *Halcyon senegalensis senegalensis*, the only specimen examined. All these birds belong to common and widely distributed species.

Further work, which is at present proceeding, is required to determine the exact significance of the virucidal bodies contained in the sera of these birds. Should further evidence show that the virucidal action is due to the development of immune bodies as a result of previous infection with the yellow fever virus, a clue may have been found to the maintenance of yellow fever in Africa, and possibly also an explanation of the occasional occurrence of sporadic infections in man at considerable intervals in space and time. Much further knowledge is required of the migration of birds within Africa. Thus the Senegal kingfisher is said to be migratory in Darfur, but there is no record of its migration in the western part of its range. The buff-backed heron, however, is known to have an extensive migratory range from the southern edge of the Sahara to the Guinea coast, thus traversing the endemic yellow fever zone from north to south. This bird is closely associated with man and with cattle.

It will be recalled that in America birds appear to play an important part in the maintenance of the eastern and western strains of equine encephalomyelitis virus: the same may be true of the yellow fever virus in Africa.

G. M. Findlay.
T. A. Cockburn.

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Synergistic Effect of Para-aminobenzoic Acid and Sulphapyridine on Penicillin

A solution of sodium penicillin, containing 1,200 units per c.c., was tested for bacteriostatic activity against *B. subtilis* and found to be active in a dilution of 1 : 100 in a synthetic medium containing 0·1 per cent acid hydrolysed casein[1].

When *p*-aminobenzoic acid was added to the medium in dilutions of 1 : 2,500–1 : 10,000, the inhibitory effect of penicillin on the test organism was increased to a titre of 1 : 6,000. An increase in the activity of penicillin on addition of *p*-aminobenzoic acid was also observed with glucose broth as nutrient medium. A similar, though less marked, effect on penicillin activity was shown by *p*-aminobenzoic acid against *Staphylococcus aureus* (strain 663) in the same synthetic medium containing hydrolysed casein. Using a solution of sodium penicillin with a titre of 1 : 40,000, the effect of *p*-aminobenzoic acid (added in a dilution of 1 : 2,500–1 : 50,000) was to increase the titre to 1 : 75,000-1 : 100,000. *p*-Aminobenzoic acid had no effect on the activity of penicillin solution against *Streptococcus hæmolyticus* (strain 618, group *A*).

p-Aminobenzoic acid did not increase the activity of penicillin in concentrations greater than 1 : 1,000.

The enhancing effect of sulphapyridine on penicillin was more marked than that of *p*-aminobenzoic acid. Sulphapyridine, which, when tested against staphylococcus (strain 663), showed no inhibition of growth in digest broth in dilutions up to 1 : 2,000, was added in dilutions up to 1 : 50,000 to a solution of sodium penicillin, which inhibited at 1 : 30,000; inhibition occurred up to a titre of 1 : 70,000. When *p*-aminobenzoic acid was added in a dilution of 1 : 20,000 to the penicillin solution containing sulphapyridine (1 : 5,000), inhibition occurred at 1 : 40,000.

The experiment was repeated using 1 per cent glucose broth, and the activity of penicillin against staphylococcus (strain 663) and streptococcus (strain 618) was again shown to be enhanced in presence of sulphapyridine. A solution of sodium penicillin inhibited staphylococcus at a titre of 1 : 20,000; in presence of sulphapyridine (in dilutions up to 1 : 50,000) the solution inhibited at a titre of 1 : 50,000. Similarly, a solution of sodium penicillin inhibited streptococcus (strain 618) at dilutions up to 1 : 50,000; in presence of sulphapyridine (in dilutions from 1 : 5,000 to 1 : 50,000), the same penicillin solution inhibited streptococcus at a dilution of 1 : 100,000. Sulphapyridine itself showed inhibition only at a concentration of 1 : 2,500. A dilution of 1 : 5,000 had no effect on the growth of steptococcus.

Thus, the inhibitory effect of penicillin in presence of small quantities of sulphapyridine, which, *per se*, are insufficient to show any effect on staphylococcus or streptococcus, is at least doubled.

Having shown *in vitro* the synergistic effect of penicillin and sulphapyridine, their action was investigated *in vivo* in mice, and some preliminary results confirming the *in vitro* experiments are recorded.

Groups of six mice were treated with (*a*) small doses of sulphapyridine insufficient to give any protection either against streptococcus or staphylococcus, (*b*) small doses of penicillin, (*c*) both substances simultaneously in these doses.

Sulphapyridine was injected in 0·5 per cent suspension and given in doses of 0·1 c.c. twice daily intraperitoneally. A solution of sodium penicillin (about 90 units per c.c.) was injected in 0·2 c.c. doses, also twice daily. Treatment was continued for four days and the results were recorded at the end of seven days from the commencement of treatment. Each group of mice was infected, at the beginning of treatment, with 1 × 10^6 streptococci (strain 618) or with 500 × 10^6 staphylococci (strain 663). The table shown below gives the number of survivals.

	Streptococcus hæmolyticus							*Staphylococcus aureus*						
Days . .	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Sulphapyridine	6	2	1	1	1	1	1	0	0	0	0	0	0	0
Sodium penicillin . .	6	5	2	2	1	1	1	4	4	2	2	1	1	1
Sulphapyridine + sodium pen. . .	6	6	6	6	6	4	4	5	5	4	4	4	4	1
Control Strept.	0	0	0	0	0	0	0	1	0	0	0	0	0	0
					↑ Treatment stopped							↑ Treatment stopped		

The results show the increased protective effect of both substances given together. This might give an even greater survival rate if treatment were extended for more than four days.

The increased activity of both substances when applied simultaneously may be due either to the synergistic action of the two substances on the micro-organism, or less probably to a chemical reaction between the sulphonamide and the penicillin. These possibilities are being investigated.

We thank the directors of the Therapeutic Research Corporation of Great Britain, Ltd., for permission to publish this communication.

It should be pointed out that penicillin is not yet available for general use.

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June 17.

[1] Ungar, J., NATURE, 152, 22 (1943).

The Development of the Angoumois Grain Moth (*Sitotroga cerealella* Oliv.)

THE Angoumois grain moth has been known as an important pest of stored and field grain since the time of Réaumur[1], and it has possibilities as a laboratory insect. A search through the literature[1–9] revealed, however, that its life-history has apparently never been worked out in detail. A knowledge of the number and duration of the larval instars at 30° C. and 70 per cent relative humidity was required for a quantitative study of populations of this species, and some observations were consequently made under these experimental conditions.

One freshly laid egg was introduced into each of a hundred small vials. The latter were then examined daily until the eggs hatched, when one gram of fine wheat flour was added to each vial. The flour had been obtained from a local miller and sieved through No. 52 (extra quadruple) silk bolting cloth. The larvæ of Sitotroga will develop quite successfully in this medium, although mortality is high. The contents of each vial were gently sieved daily, and moults deduced from the discovery of cast skins and checked by measuring the width of the head capsule. Four larval instars were found, followed by a pupa, from which the adult eventually emerged. Mature larvæ were found in hollows in the flour, lined by a delicate cocoon, against the glass side of the vial. They became quiescent for about two days before metamorphosis. The average duration and body measurements of each instar are shown in the accompanying table. The average ratio of increase in each instar, used in the calculations from Dyar's rule, was 1·7.

Instar	Duration in days		Width of head capsule (mm.)	Width of head capsule, calculated from Dyar's rule	Approx. width of thorax (mm.)	Approx. total length (mm.)
	Mean	Range				
Egg	3	2– 7				
First larval	6	4–10	0·15–0·19		0·22	1·2
Second larval	6	4–10	0·28–0·32	0·29	0·38	1·6
Third larval	5	2– 9	0·47–0·53	0·51	0·80	4·3
Fourth larval	7	6–12	0·76–0·84	0·85	1·65	7·0
Pupa	5	4– 7				
Total	32	30–40				

The body measurements are each the averages of observations of five individual larvæ, and the developmental periods the averages of observations of at least twenty-one individuals. Only twenty-two adults emerged from the hundred original eggs, twenty having been killed to make body measurements and fifty-eight dying. Twenty-one of these adults emerged within ten days of each other, while one did not emerge until the seventy-second day after oviposition. Such prolonged development has been observed by other authors[2,3], but under uncontrolled conditions of temperature and humidity. This abnormal individual was disregarded in calculating the average duration of the different instars. All its larval instars were longer than the average, while the pupal period was of average duration. The moths usually mated almost immediately upon emergence, and the pre-oviposition period was approximately one day. The average generation time was thus thirty-three days.

This is a suitable opportunity to correct an omission from a previous paper[4]. In line 11 from the bottom of p. 330, for "insects per grain" read "insects per grain, at which densities the average longevity was 6·6 and 4·4 days, respectively".

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Aug. 5.

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Frictional Properties of Metallic Films

DR. HUGHES's recent remarks[1] would appear to be based on the three wrong premises that, first, films of soft metals wiped on to steel surfaces on which a loaded steel ball was made to rotate[2] never decreased the electromotive force ; secondly, the interpretation of earlier observations[3] on the frictional behaviour of such films on a copper surface made on the Bowden-Leben apparatus had been criticized ; and thirdly, frictional decreases due to these films should be taken as an indication that changes in the ploughing contribution to the frictional force were immaterial when such decreases were observed "during the *first* slide" with the Bowden-Leben apparatus.

Dr. Hughes, it seems, has overlooked the difference of the results obtained with the revolving sphere and metallic films wiped out once under 'dry' conditions, and the other time in the presence of an oil. It has been stated[2] that "Even in those cases in which the films reduce the electromotive force under 'dry' conditions, they do not appear to function as a lubricant for a brief interval until normal lubricating conditions are re-established".

The results listed in Table 2 (ref. 3) allow of no misrepresentation, and it is the conclusion drawn by Dr. Hughes and his colleagues[3] from a comparison of Tables 1 and 2 (ref. 3) that "in a heterogeneous bearing metal the soft phase wipes out over the hard phase during sliding": that is regarded as conjectural.

There is a difference between wearing in a groove on the surface of a block of compact metal and of ploughing a track on a film of wiped-out softer metal of sufficient thickness to carry the main portion of the normal load. To choose a homely analogy, it is qualitatively the same difference as between scribing a line with the end of a walking-stick once on a hard rolled gravel path and then on the same path covered with a reasonable amount of loose gravel. One is bound to experience a frictional decrease "during the *first* slide" in the latter case. Just on account of the ploughing action would one expect a smaller friction "during the *first* slide" in the presence of a wiped-out metallic film, the friction remaining little changed by successive strokes in the same track, *until* the wiped-out films would be penetrated, when the friction would be expected to *rise* to values approaching that of steel on the substrate—copper, for example—and on further continued successive strokes in the same track a renewed decrease of the friction would be expected with the wearing in of *one* groove in the substrate.

There seems to be general agreement[1,2,4,5] that ploughing is the essential feature of the Bowden-Leben apparatus when the hemisphere is the harder of the two friction elements, since Dr. Hughes's claim has remained unsubstantiated "that the grooving contribution to the friction, which must evidently be present to a certain extent, is small compared with the contribution of adhesive forces".

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Manchester.
June 11.

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[2] Schnurmann, R., NATURE, 151, 420 (1943).

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IN the light of Dr. Schnurmann's above remarks, it appears that he is still unconvinced by our original interpretation of frictional data[1] on the Bowden-Leben apparatus, when a small steel spherical surface was slid over copper covered with thin films of soft metals (lead, cadmium and tin), and also by later additional experimental data[2]. It was originally suggested that the reduction in the coefficient of friction, μ, from 0·5 to 0·7 for steel on the bulk metals lead and copper, say, to 0·03–0·08 for films of lead, 10^{-5}–10^{-6} cm. in depth, was due to the combination of a thin soft film on a hard substrate maintaining a small area of contact across which "the adhesion and deformation resistance" was very low. Dr. Schnurmann considers the effect is solely due to a reduction in the "ploughing action".

It would perhaps clarify the argument if an attempt is made to define these terms. The frictional force may be considered to be made up of two contributions[3,4] :

(i) The *adhesion forces* across the real area of contact. This is the shear strength of the metal junctions in Dr. Bowden's recent publications[4,5,7].

(ii) The *deformation forces* required to plough out a groove. This is the ploughing term, the magnitude of which for indium films on steel has been investigated by Bowden, Moore and Tabor[5]. This contribution to the friction may be defined as the force required to deform the metal in the path of the slider, and would contribute to the total friction even if the adhesional forces across the area of contact became zero. The greater drag of a ski on soft snow above that on hard crusted snow is perhaps a simple illustration of a case where the ploughing term is relatively large.

If we consider our original experiments, when a steel ball 2 mm. in diameter was slid over copper and copper covered with a thin film of lead (which recent measurements[6] have shown need only be about 5×10^{-6} cm. in depth for the minimum friction), then since the track width is of the order of 0·02 cm., a simple calculation will show that the area of contact on the bare and lead-covered copper will be practically the same in both cases, since the thin film thickness is only a small fraction of the depth of the sliding groove. This must indicate that the ploughing term is approximately the same in each case. However, since the friction experiments show a tenfold drop in μ to accompany the deposition of this lead film, it must be concluded that *it* is the lower adhesion (or shear strength) between the lead and the steel slider compared with that between copper and steel which is responsible for the drop in μ.

This argument has been put on a quantitative basis in Dr. Bowden's recent publications[4,5,7]. By comparing different forms of slider on soft indium films deposited on hard steel, he has been able to estimate the ploughing and adhesion contributions to the friction for comparatively wide track widths up to 0·2 cm. Thus Fig. 9 of ref. 5 shows that the adhesion term is much greater at low track widths, that is, for the thinnest films such as those used by us. The proportionality between the square of the track width (that is, the area of contact) and the frictional force has been used to show the dependence of the friction on the shear strength across the area of contact, that is, on the adhesion term. It has not been used to support the ploughing hypothesis, as Dr. Schnurmann implies above.

Dr. Schnurmann's analogy of a walking-stick sliding on a gravelled path is perhaps rather ill-chosen on account of complications due to grain rolling; we prefer our original analogy of the lubricating action of lead on a copper substrate being similar to that of a thin film of mud on a smooth road, when the area of contact between a pedestrian or motor vehicle and the road is little different from that on the dry road, while the fall in kinetic friction is a matter of common experience.

Incidentally, Dr. Schnurmann's expectation of a rise in μ followed by a further decrease after breaking through the lead film on copper is at variance with facts. Experiments show the friction to increase from $\mu = 0{\cdot}05$–$0{\cdot}08$ to $\mu =$ greater than 0·3 as the lead film is worn through, until as continued sliding causes copper to pick up, μ may reach a value above unity, and never decreases with further sliding.

If Dr. Schnurmann's results[8] have been incorrectly represented in a previous communication[2], one of us (T. P. H) must plead a misinterpretation of the experimental observations, which on account of their brevity were perhaps somewhat ambiguous. It is, however, difficult to see how the thermo-electric E.M.F. between pairs of sliding surfaces covered with various metal films (each metal having a different thermo-electric E.M.F.) can be considered as a certain measure of the friction μ. No doubt this point will be cleared up when Dr. Schnurmann's detailed results are published at a later date.

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[1] Heaton, J. L., Bristow, J. R., Whittingham, G., and Hughes, T. P., NATURE, **150**, 520 (1942).

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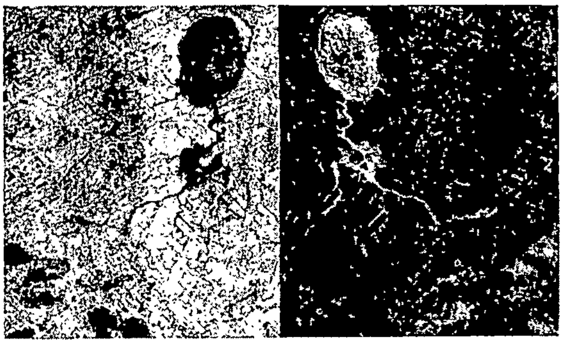
Recording Low Relief in Metallic Surfaces by Cellulose Acetate Moulds

A THIN transparent sheet of cellulose acetate, bearing on one face an accurate mould of the low relief produced in a relatively flat metal surface by abrasion, etching or impact, constitutes a useful permanent record of this relief for comparative purposes. It is superior to a photograph in being three-dimensional, but serves as a negative for photographic copies, if necessary.

Such a mould reproduces both megascopic and microscopic details with exceptional clarity. In particular, it facilitates (*a*) studies of crystalline structures revealed by polished and etched serial sections of ingots, and (*b*) investigation of the changes produced in crystalline structures of polished and etched metallic test specimens by different types of mechanical working.

Recently the method has been utilized for examining polished and etched plane sections of metallic meteorites, iron ores, steels, and brasses. Previously I employed this procedure for investigating the finer structures of rock and mineral surfaces[1]. It is allied to the collodion-mould technique of A. G. Nathorst[2], and the 'peel' technique of J. Walton[3] for studying fossil plants.



POSITIVE PRINT (RIGHT) AND ITS PAPER NEGATIVE DERIVED FROM A CELLULOSE ACETATE MOULD (LEFT) OF THE POLISHED AND ETCHED SURFACE OF A METALLIC METEORITE FROM CAÑON DIABLO, ARIZONA, U.S.A. (HUNTERIAN MUSEUM COLLECT., UNIVERSITY OF GLASGOW).

The mould was 0·08 mm. in thickness and the paper negative made on "Kodaline Slow Paper"; exposure 15 sec. at 30 in. from 100-watt lamp.

A mould is produced from a colourless or dyed dispersion of cellulose acetate in one part by volume of tetrachloroethane and two parts by volume of "Cerric Thinner T. 10" (Cellon, Ltd., Kingston-on-Thames) by (*a*) wetting the cleansed metal surface with some of the dispersing medium; (*b*) levelling and then flowing over this surface a layer of the dispersion, 1–1·5 mm. in depth; (*c*) removing the resulting cellulose acetate film from the surface when volatile parts of the dispersing medium have evaporated; that is, in eight to twelve hours after flowing the layer. Premature stripping of this film from the metal (for example, in four hours) may result in distortion of relief arising from slight shrinkage of the mould parallel to the plane of the metal surface.

This simple process yields strong transparent moulds of refractive index $N_D^{20°}$ 1·49, which are usually between 0·1 mm. and 0·2 mm. in thickness, as much as 1,200 sq. cm. or more in area, light in weight, very flexible, and insoluble in water, cold concentrated hydrofluoric acid, hot Canada balsam and xylol balsam. If such a film is to be kept for reference, its flexibility can be preserved, and ultimate shrinkage reduced, by adding to the dispersion a cellulose acetate plasticizer, such as triphenylphosphate or dimethyl-phthalate, in proportion to the percentage of cellulose acetate present.

The metallic surface is not damaged in any way by the moulding process, but any dust or parts of oxide or other detachable films are removed, and retained by the mould.

For comparison, moulds can be superposed and examined over an illuminated tracing desk. Alternatively, critical parts of them can be cut out and mounted in 'cooked' Canada balsam, for examination under the microscope at any convenient magnification up to about 500 diameters, or by optical projection.

The utility of the method is now being tested in connexion with slags, glasses, ceramic products and refractories.

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A Neglected Constituent of Proteins, α-Amino-*n*-butyric Acid

ALTHOUGH its presence in proteins has been reported several times[1–6], α-amino-*n*-butyric acid has not been generally accepted as a naturally occurring amino-acid, probably because no readily reproducible method for its isolation has yet been described. However, the isolation of its hydroxy homologue threonine[7] suggests that α-amino-*n*-butyric acid may occur widely, since whenever a known hydroxy amino-acid occurs in any given protein, the corresponding simple amino-acid is usually present in even larger amounts. Accordingly, it seems probable that an appropriate fractionation of the alanine and valine fractions of a protein rich in threonine would yield appreciable amounts of α-amino-*n*-butyric acid. Hydrolysis should preferably be enzymatic, since prolonged heating with mineral acids has been found to liberate some nitrogen from the synthetic *dl*-α-amino-*n*-butyric acid[8], while *l*-glutamic acid heated with alkalis decomposes to acrylic acid and α-amino-*n*-butyric acid[9], so that misleading results would be obtained by alkaline hydrolysis of proteins. Preliminary work along these lines has been interrupted by the War.

Meanwhile, synthetic *dl*-α-amino-*n*-butyric acid has been increasingly used in comparative studies on amino-acids. No appropriate common name for the amino-acid has yet been proposed. Since the full chemical name is somewhat cumbersome, the term *quadrine* is suggested as a common name. This is intended to call to mind the fact that the acid contains four carbon atoms. α-Amino*iso*butyric acid could be designated as *isoquadrine*.

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Cleavability of Keratins Treated with Hot β-Naphthol by Proteinases

WHEN sheep wool is heated with β-naphthol at a temperature of 140–150°, it dissolves; and when after cooling the β-naphthol is removed with ether, an amorphous yellowish substance is obtained in a yield of about 80 per cent of the weight of the wool. This product is readily hydrolysed by a glycerol extract of pancreatin, purified pancreatic proteinase (free of peptidases and protaminase), pepsin, and taka-diastase. Yeast polypeptidase does not affect the product but causes additional hydrolysis after a prior treatment of the product with pepsin.

In a similar manner, chicken feathers were dissolved in hot β-naphthol. The product that remained after removal of the β-naphthol is almost completely soluble in hot 70 per cent alcohol and is precipitated from this solution by an excess of absolute alcohol. The product so obtained is readily cleaved by a glycerol extract of pancreatin, by purified pancreatic proteinase and by pepsin. Like the product obtained from wool, it is resistant to yeast polypeptidase but is cleavable by the latter after a previous exposure to the action of either pepsin or purified pancreatic proteinase.

The products obtained from the two keratins thus behave toward proteolytic enzymes like the 'acropeptides' earlier obtained in a similar manner from other proteins by A. Fodor and collaborators[1].

The experimental part of this investigation was carried out in collaboration with Miss S. Cukerman and Mrs. I. Fodor-Salomonowicz. A detailed report will be published elsewhere.

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[1] cf. "Annual Review of Biochemistry", **9**, 47 (1940).

Vacuum Filtration of Sewage Sludge

VACUUM filtration of sewage sludge, particularly surplus activated sludge from the activated sludge process of sewage treatment, is a well-established process, particularly in the United States, for dewatering sludge prior to drying and incineration or preparation for use as fertilizer or disposal by other means. It has been found from long experience that for successful filtration the sludge must be coagulated beforehand. The coagulant generally used is a ferric salt, usually ferric chloride, and many attempts have been made to reduce the amount of coagulant required with the view of making the process more economical.

Experiments are being conducted on these lines at Manchester Sewage Works, and the finding of other workers[1] has been confirmed that the fresher the sludge the less ferric chloride is required for coagulation. It has also been found that the better the 'condition' of activated sludge from a sewage purification point of view the less ferric chloride is required for coagulation. When activated sludge is kept for periods up to two days, it becomes more alkaline, and this increases the ferric chloride demand. When activated sludge, or a mixture of activated sludge and sedimentation tank sludge, is stored, reducing substances are produced, and these by reducing part of the ferric salt to ferrous salt increase the ferric chloride demand. Aeration of stale activated sludge, or a mixture of activated sludge and sedimentation tank sludge, for a short period (one to two hours) reduces the alkalinity and appreciably reduces the amount of ferric chloride required for coagulation. This may be due in part to oxidation of the reducing substances referred to above. Aeration is beneficial even with the freshest sludge obtainable from the activated sludge plant.

We believe that aeration of sewage sludge, as a preliminary to coagulation and vacuum filtration, has never before been reported. It is hoped shortly to publish the results of the experiments.

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INFECTION OF LABORATORY ANIMALS WITH JOHNE'S DISEASE AND LEPROSY

By JOHN FRANCIS

JOHNE'S disease chiefly affects the bovine. It is a chronic bacterial enteritis caused by *Mycobacterium johnei* which produces proliferative changes in, and a rather characteristic thickening of, the intestinal mucosa. The bacteria are usually confined to the intestine and adjacent lymphatic glands. Animals acquire the infection when very young, but the incubation period is protracted, symptoms usually not occurring until two to three years of age or even later; calving or other stresses may cause the onset of symptoms. Clinical recovery may occur, but usually the diarrhœa and emaciation are progressive, eventually resulting in death.

Several workers have remarked on the similarities between the histopathology of Johne's disease and leprosy, and in both the bacteria are largely intracellular. The respective organisms resemble each other in that neither will grow on the usual culture media, and until recently it was generally accepted that laboratory animals had not been infected with *Myco. lepræ*, or with *Myco. johnei*. There was, however, considerable evidence that even naturally susceptible animals became resistant to infection with *Myco. johnei* at an early age, but there was no evidence that young laboratory animals had ever been used in experimental work[1]. I therefore attempted to produce infection by inoculating very young laboratory animals.

Four mice, fourteen days old, were each given intraperitoneally 2·5 mgm. moist bacilli from a culture of *Myco. johnei*. (The organisms were grown on an egg medium containing an extract of *Myco. phlei*. The use of this extract was first described by Twort and Ingram in 1913, see ref. 2.) The animals were re-inoculated with the same dose seven days later. Post-mortem examinations were carried out 9–34 weeks after inoculation, and showed that a progressive infection, commencing in the liver and spleen and eventually involving almost the whole of the intestinal tract, had developed. Seven mice, thirteen days old, received liver tissue from one of these infected mice. The bacilli multiplied in the second group of mice more rapidly than in those originally inoculated. The results of a second mouse passage were largely vitiated due to the early death of the inoculated mice. Another group of thirteen-day-old mice was inoculated with a total dose of 1·4 or 1·25 mgm. of culture from the spleen of an infected mouse. Three of these mice rapidly became heavily infected, but two, killed later, were negative and a third was only lightly infected. Slight infection was also produced in young hamsters, but on the basis of their weights the doses they received were approximately three times smaller than those given to mice. The result was less consistent, but bacilli were carried through one direct animal passage. The cellular reactions in infected mice and hamsters were similar to those in naturally occurring Johne's disease.

Young rabbits and guinea pigs appeared to be less susceptible to Johne's disease than mice or hamsters.

The numerous attempts to infect laboratory animals with *Myco. lepræ* have been reviewed by McKinley[2] and only a few of the more recent need be considered here. Adler[3] splenectomized four 'young' hamsters (*Cricetus auratus*). A fragment of lepra nodule was placed subcutaneously in the operation wound of three of them and in the fourth a fragment was placed in the thigh muscle; material was also inoculated intraperitoneally. One died and no post-mortem examination was performed. The other animals were killed forty days after inoculation. It was claimed that in the remaining two hamsters inoculated subcutaneously local multiplication had occurred and that bacilli were found in the liver. Bacilli were found in the adjacent lymphatic gland of the hamster inoculated in the thigh muscle.

Burnet[4] inoculated six three-month-old hamsters subcutaneously with fragments of leprous tissue. Three of them were splenectomized and three normal. They were inoculated again 15 weeks later and killed 150–220 days after the first inoculation. Only one of the hamsters, which had not been splenectomized, was infected. It had masses of bacilli at the inoculation site and large numbers in the spleen, liver, kidneys, some lymphatic glands and in a testicular abscess. Inoculation of tissue into guinea-pigs showed that this animal was not affected with mammalian tuberculosis.

Burnet and Jadford[5] fed large amounts of leprous skin and spleen to a hamster over a period of twelve days. The hamster died 300 days later after having shown symptoms of malaise. Numerous acid-fast bacilli were found in the spleen and lung, and it was concluded that an active infection had been produced.

De Souza-Araugo[6] inoculated five hamsters (*Cricetus cricetus*) subcutaneously and intraperitoneally with human leprous material; they were given a second subcutaneous inoculation 75 days later. Bacillæmia was demonstrated in three hamsters 163 and 192 days after the first inoculation. Ota and Nitto[7] failed to infect hamster (*Cricetus cricetus*). De Souza-Araugo[6] and Dhamendra and Lowe[8] criticized the validity of Adler's claim to have produced a true infection in hamsters and the latter workers attempted to infect twenty-six adult hamsters, half of which had been splenectomized. Leprous material was inoculated subcutaneously and intraperitoneally but a progressive infection was not produced. Burnet[9] failed to infect hamsters following intra-nasal inoculation.

De Souza-Araugo[10] reported extensive attempts to infect laboratory animals. He claimed[6] that of fifty-nine adult mice, inoculated intraperitoneally with leprous material, 92 per cent developed "systemic infection" (ref. 3). An examination of the results indicates, so far as one can judge, that six or perhaps nine animals developed a true infection. Attempts to infect rats and guinea pigs were less successful.

Jordan[11] inoculated material from typical cases of skin leprosy intradermally into 3–4 month-old white rats. In some of the animals a superficial tumour was produced after 1¼–1½ years. Tissue from these tumours was used for further inoculations. In all, seven passages were carried out in rats and the incubation period was reduced to three–four months, After the first passage, lesions developed in the lung, liver, spleen and kidney; bacilli were not found in the nose. Guinea pigs inoculated with infected material did not become tuberculous. The possibility of the infection being rat leprosy was considered and dismissed: twenty uninoculated rats of the same strain as those used in the experiments died of intercurrent infection, and no acid-fast bacilli were found in their organs. Photomicrographs of lesions in the liver and spleen of infected rats show that the tissue reaction was of the same type as that seen in mice infected with *Myco. johnei*. These are by far the most convincing results so far reported, but they have not been confirmed by other workers and no subsequent paper by Jordan can be traced. Fite[12] inoculated 154 rats, some of which were young, subcutaneously with human leprous material. Six developed a local leprous lesion after an incubation period of 17½–18 months, and in two of them the possibility of a spontaneous rat leprosy infection was as nearly as possible excluded. Material from two rats was inoculated subcutaneously into twelve other rats, ten of which became infected; a second transfer resulted in uniform takes in twelve rats. Unfortunately, the possibility of these rats becoming infected with rat leprosy was not completely excluded. Tisseuil[13] failed to produce progressive infection in rats inoculated subcutaneously with leprous material suspended in various excipients.

Nanoka[14] failed to produce a progressive infection in young chickens inoculated in the breast muscles with leprous material, but Ota and Nitto[7] claim to have carried out six consecutive passages in fowls by mixing the leprous emulsion with Kieselgühr, trypan blue and potassium iodide.

Taken together, the attempts to infect laboratory animals with leprosy are disappointing. Summarizing his results, Burnet[15] states that, of thirty-five hamsters and sixty-three other animals of various species, only two hamsters were infected (these animals have already been described). He concludes that the exact susceptibility of the hamster to *Myco. lepræ* is not yet known, but that it is certainly variable and probably not much greater than that of mice and rats. One feels that the results obtained by De Souza-Araugo[10] in mice and Jordan[11] in rats were quite as promising as those so far obtained with hamsters.

The difficulty of infecting laboratory animals with leprosy is not surprising, because, of some hundred and forty-five experimental attempts to infect man, no fully accepted positive results have been obtained[1]. But leprosy also resembles Johne's disease in that there is a very long incubation period, and children are much more susceptible than adults. The Philippine Islands Leprosy Commission concluded that children are especially susceptible, and that for all practical purposes adults may be considered as immune (Dunham[16]). Rogers and Muir[17] also say that in the control of leprosy "the protection of highly susceptible children is the key to the solution of the problem". They point out that the negative results of the experimental attempts to infect man are of little significance because they were all carried out on adults who had passed the most susceptible age period. They emphasize that in each of four cases of reported infection through vaccination, the patients were children or adolescents of the most highly susceptible age period. They also record two cases in which a child became infected as a result of thrusting a thorn or a needle into himself after it had been removed from the flesh of a leper. "These last two cases have a special significance owing to their having occurred in children of a highly susceptible age, while two such cases can hardly have both been coincidences."

In all the attempts to infect laboratory animals with leprosy, only a few workers have used 'young' animals. There have, however, been no systematic attempts to ascertain the age susceptibility of any species. The similarities between *Myco. johnei* and *Myco. lepræ* and the diseases they produce have been described. In view of the successful results which have been obtained by inoculating very young mice with *Myco. johnei*, it is felt that an attempt to produce *Myco. lepræ* infection by inoculating very young laboratory animals would be fully justified.

Summarizing, neither *Myco. johnei* nor *Myco. lepræ* will grow on ordinary culture media; they also resemble each other in that they are largely intra-cellular parasites and produce the same type of tissue reaction. Adults, even of the naturally susceptible species, are at least partially resistant to Johne's disease and leprosy, and in both there is a long incubation period. Attempts to produce either of these diseases in laboratory animals have not generally been successful. Mice have now been infected with *Myco. johnei* by inoculating them when very young, and it is concluded that an attempt to produce *Myco. lepræ* infection by inoculating very young laboratory animals might meet with success.

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EVOLUTION OF THE PLANETARY SYSTEM

WITHIN the last twelve months, a considerable amount of interest has been shown in theories of the origin of the planets and satellites. Two new theories have been advanced, notices of which appeared in NATURE (**150**, 215, and **151**, 200), and now another theory by Lieut.-Colonel K. E. Edgeworth has just been published (*J. Brit. Astro. Assoc.*, **53**, 6; July 1943).

The author starts with a vast cloud of scattered material—gas, dust and small particles with an average diameter of 0·5 cm.—and assumes that this cloud was rotating with angular velocity increasing towards the centre. Owing to inelastic collisions, random velocities were reduced and the rotating cloud became a thin disk in which there occurred an increase in local densities, instability finally taking place. Local condensations, each possessing its own rotation, were formed, but these rotations were slowed down through viscosity, and there was an increase in the central density of each condensation. In many cases these condensations broke up into smaller ones but some coalesced into a number of larger ones by their attraction, and from these larger agglomerations the planets and satellites were formed. The mechanism by which the planets were formed was not necessarily the same as that which was responsible for the formation of the sun, and different suggestions are made regarding this last point, but the author hopes that further investigation will decide which view will be most likely.

The satellites were formed in a similar manner to the planets, the scattered material surrounding the planets forming local condensations which coalesced to form satellites. In the case of the moon and other large satellites, like Titan and Triton, it is suggested that this mechanism was not in operation, and it is thought that the moon was formed of the same primitive material as the earth. The asteroids were formed from condensations which failed to coalesce into larger agglomerations, the perturbations of Jupiter being responsible for this effect. The comets were formed in a cloud of scattered material which may still extend far beyond the orbit of Pluto. Owing to the diffuse condition of the material the condensations did not coalesce, merely condensing on self. While the asteroids developed sufficient cohesion to form solid bodies, the comets remained a mere collection of loose particles. Probably, the great difference of temperature was responsible for this divergence of development.

The theory is stated in a very tentative form and a large amount of detail still remains to be developed. No doubt the author will clarify a number of points which appear to present certain weaknesses in the theory.

THE MUMBWA CAVES, NORTHERN RHODESIA

THE Mumbwa caves have long been known. Yet, in spite of the fact that in South Africa prehistoric cave sites are few and far between, only now has efficient and systematic investigation been undertaken. F. Macrae, many years ago, was the first to make some trial excavations, the resulting finds from which are in the Cambridge Museum of Archæology and Ethnology, but no complete investigation was attempted. Macrae unearthed a really fine Acheulean type of *coup de poing* in the basal level, and this was covered by other layers containing poor Middle Stone Age industries. A characteristic feature was the number of spherical stone balls found. Now at last a detailed account of the whole section actually present has been prepared ("Further Excavations (1939) at the Mumbwa Caves, Northern Rhodesia", by J. Desmond Clark, *Trans. Roy. Soc. of S. Africa*, 29, Pt. III).

At once it must be remarked that the so-called furnace with iron slag said to have been found in the middle levels by a previous investigator (not Macrae) has been shown to have probably been a grave, while the 'slag' has been proved to be merely a brown cave deposit of sand and silt cemented by calcium phosphate and carbonate. Clark found no more lower palæolithic artefacts, and it would seem that the inhabitants of the Mumbwa sites in those times cannot have been numerous. Macrae was evidently lucky. Above the lowest level comes an industry called by Clark the Rhodesian Stillbay, and this in turn is overlain by a Northern Rhodesian Wilton, the whole being capped by a layer containing iron objects. The finds are well illustrated and carefully analysed, and comparisons are made with other discoveries in the region and at the classic sites.

A section on the geology of the caves has been supplied by F. E. Zeuner, and the author has had the advantage of collaborating with I. F. Schofield when describing the Iron Age culture from the uppermost layer. The article as a whole is a very useful piece of work. M. C. BURKITT.

FORTHCOMING EVENTS

Saturday, September 4

BRITISH PSYCHOLOGICAL SOCIETY (at Tavistock House, Tavistock Square, London, W.C.1), at 2 p.m.—"On the Problem of Representative Sampling of the Population".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

TEACHER OF MINING SUBJECTS—The Education Officer, County Hall, Wakefield (September 1).

EDUCATIONAL PSYCHOLOGIST AT THE CHILD GUIDANCE CLINIC—The Chief Education Officer, Education Offices, Northern Secondary School, Mayfield Road, Portsmouth (September 4).

ADVISORY MYCOLOGIST—The Secretary, North of Scotland College of Agriculture, 41½ Union Street, Aberdeen (September 4).

LECTURER IN ELECTRICAL ENGINEERING of Degree standard for National Certificate Course, at the South-East London Technical Institute, Lewisham Way, S.E.4—The Education Officer (T. 1), County Hall, Westminster Bridge, London, S.E.1 (September 4).

TEACHER FOR THE CORRECTION OF SPEECH DEFECTS—The Director of Education, Education Offices, Town Hall, Hanley, Stoke-on-Trent (September 11).

HEAD OF THE DEPARTMENT OF MATHEMATICS—The Principal, Heriot Watt College, Edinburgh (September 20).

HEADS OF THE DEPARTMENTS OF PHYSIOLOGY, MEDICINE, AND SURGERY—The Bursar, Royal Veterinary College and Hospital, at The University, Reading (October 1).

CHAIR OF NAVAL ARCHITECTURE—The Acting Secretary of University Court, The University, Glasgow (October 4).

DIRECTOR OF ROBERT GORDON'S TECHNICAL COLLEGE—The Secretary, Robert Gordon's Technical College, Aberdeen (October 16).

LECTURER IN ELECTRICAL ENGINEERING for part-time students taking London University Examinations to Final B.Sc. and Higher National Certificate standards—The Principal and Organizer of Further Education in Rugby, College of Technology and Arts, Eastlands, Rugby.

TEACHERS FOR EVENING CLASSES IN CHEMISTRY up to Intermediate Science standard—The Director of Education, The Polytechnic, 309 Regent Street, London, W.1.

ASSISTANT PORT HEALTH OFFICER for the Basrah Port Directorate, Government of Iraq—The Secretary, Overseas Manpower Committee (Ref. 1034), Ministry of Labour and National Service, Alexandra House, Kingsway, London, W.C.2.

DEPUTY CHIEF CHEMIST—The General Manager, Liverpool Gas Company, Bold Street, Liverpool 1 (endorsed 'Chemist').

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Medical Research Council. Special Report Series, No. 244: Chronic Pulmonary Disease in South Wales Coalminers, 2: Environmental Studies. A.: Report by the Committee on Industrial Pulmonary Disease; B.-G.: Reports on Physical, Chemical and Petrological Studies, by Dr. T. Bedford and Dr. C. G. Warner; Prof. H. V. A. Briscoe, Dr. P. F. Holt, Dr. N. Spoor and others; Dr. G. Nagelschmidt; Dr. A. Brammall and Major J. G. C. Leech; D. Hicks and Dr. G. Nagelschmidt; J. Ivon Graham and Dr. D. F. Runnicles; and co-workers. Pp. xi+222. (London: H.M. Stationery Office.) 10*s*. 6*d*. net. [48

Mycological Papers No. 6: Colour Terminology in Biology. By H. A. Dade. Pp. 25. (Kew: Imperial Mycological Institute.) 3*s*. 9*d*. net. [58

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 14, No. 2, September 1942. Compiled by Agnes Elisabeth Glennie, assisted by Catherine Alexander. Pp. iv+73–150. (London: H.M. Stationery Office.) 4*s*. 6*d*. net. [128

Other Countries

Report and Accounts of the National Botanic Gardens of South Africa, Kirstenbosch, Newlands, Cape (and the Karoo Garden, Whitehill, near Matjesfontein) for the Year ending 31st December 1942. Pp. 12. (Kirstenbosch: National Botanic Gardens.) [58

Uganda Protectorate. Annual Report of the Forest Department for the Year ended 31st December 1942. Pp. 8. (Entebbe: Government Printer.) 1*s*. [68

U.S. Department of Agriculture. Technical Bulletin No. 848: The Ecology of the Principal Summer Weed Hosts of the Beet Leafhopper in the San Joaquin Valley, California. By F. R. Lawson and R. L. Piemeisel. Pp. 38. (Washington, D.C.: Government Printing Office.) 10 cents. [98

Catalogues

A Catalogue of Miscellaneous Books in English History and Literature printed after 1700, followed by a selection of Recent Purchases including the series of Chronicles and Memorials published under the direction of the Master of the Rolls, Fine Arts, Natural History, Works by William Prynne, Sports. (No. 612.) Pp. 40. (London: Bernard Quaritch, Ltd.) 3*d*.

An Improved Design of Portable Three-Cup Anemometer. (Leaflet 661.) Pp. 4. (London: C. F. Casella and Co. Ltd.)

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SCIENCE AND NATIONALITY

SCIENCE is one of the spheres of human activity which knows nothing of boundaries and frontiers, of races and creeds. It appeals neither to tradition nor sentiment, it has no folk-lore or legends. Its study is free to all, it speaks in one language, it has but one object, but it is the handmaid of all art, all industry and all human progress. "Science, like Nature, to which it belongs," said Davy, "is neither limited by time or space. It belongs to the world and is of no country and no age." Pasteur's view was that "Science has no nationality because knowledge is the patrimony of humanity, the torch which gives light to the world". It is justifiable to write of Chinese art, Byzantine art, Moorish architecture, Italian painting, Greek sculpture and Russian literature, but science cannot be divided into such chapters. The contributions of the ancient, the medieval and modern worlds and of all continents are interwoven and inseparable. Illimitable in its extent, the edifice of science may be compared with the temple of art of which Lafcadio Hearn wrote to the musician Krehbiel. In this temple, he said, "the more you advance the more seemingly infinite becomes the vastness of the place, the more interminable its vistas of arches and the more mysterious its endless succession of aisles. . . . The Vatican with its sixty thousand rooms is but a child's toy house compared with one of the countless wings of art's infinite temples." In the erection of this great structure of science, a multitude from many lands have assisted, and their work is seen to-day in the sky and on the sea, in factory and field and around our hearths and homes, touching every side of life.

But though science knows nothing of frontiers and boundaries, its investigators have homes and belong to some particular community, and it is but natural that these communities should take a special pride in their notable men, upholding their reputation and honouring their memory. Thus it comes that memorials are set up where the great were born, where they laboured and where they died, and such memorials become the shrines around which on appropriate occasions commemorations are held.

The question of what it is that moves all mankind to commemorate its great men was asked and answered by the late Prof. Wilfred Trotter in his Hunterian Oration to the Royal College of Surgeons of England on February 15, 1932. "The *conscious* and *ostensible* motives," he said, "under whose influence we approach the commemoration of great men are first, to contemplate in humble piety and emulation a largeness of mind and character that far exceeds our own, and secondly to seek inspiration from struggles heroically engaged and perhaps triumphantly won." Elsewhere it was written: "we commemorate to instruct ourselves, to inspire others to act in a way similar to that of the men we revere, perhaps most of all to impress the fact of the debt of the living to the past". In the first of his seven essays on "Representative Men", Emerson remarked, "The knowledge that in the city is a man who invented the railroad raises the credit of all the citizens". As with a city so with a nation, and one cannot but feel his own status raised by the knowledge that the great men of the present or the past belong to his own community, and all gain something from association with historic places connected with notable events or outstanding men. We all have our heroes, from whom we gain vigour and resolution, for as Carlyle said, they are "profitable company". If the hero is a Pasteur so much the better, for he it was who advised the students of Edinburgh "to associate the cult of great men and great things with every thought". It is given to but a few to come into intimate contact with the really great, but no student of science need lack knowledge of the lives and characters of famous men of science, for biographies and histories abound. It may be, as Prof. Trotter said, that "in all our commemorations, whether by word or plastic act, we make our own pictures and drift increasingly away from the actual man"; but pictures we must have, and our debt is great when a biographer succeeds in delineating vividly the man of whom he writes. "In the written records of the lives of men and women," said Lord Oxford, "we have all a common territory, inexhaustible in its range, permanent in its interest, from which pedantry itself cannot shut us out."

Inspiring and valuable as the biographies of men of science may be, still more important are the histories of science which, when written in an impartial spirit by men of knowledge and experience, provide those broad and unbiased views which are the birthright of every student. Men of science have come from all classes and all lands, a Siberian town giving birth to a Mendeléeff, a Serbian village to a Tesla and an Indian home to a Ramanujan. When von Zittel was asked to write his history of geology, it was suggested that he should record chiefly the progress of that science in Germany, but he was unwilling to accept any such limits. "All civilized nations," he wrote, "have shared in the development of the natural sciences, the history of any one of which is to a certain extent the history of a scientific freemasonry." His countryman, Prof. Matschoss, of whose death we regret to learn, in the preface to his excellent book "Great Engineers" took much the same view, remarking that "Technology is not confined within frontiers, and there is nothing in it that anyone can do entirely alone. The threads run from nation to nation and from generation to generation."

The records of all important scientific societies give evidence of the international character of science, and it is one of their self-imposed tasks to recognize outstanding achievements in lands beyond their own. The lists of the foreign associates of the Paris Academy of Sciences, the roll of the Copley medallists of the Royal Society, and the table of the Nobel laureates all illustrate the scientific freemasonry of von Zittel. Unfortunately, war between nations always brings in its train boasting and jealousy, gravely injuring the feeling of brotherhood, but in the end histories of science have little to say about dictators or tyrants, conquests or defeats. When the present disastrous struggle ends, it will be the privilege of men of science to attempt to allay national animosities and to resume speedily the friendly relations of happier times. It is much to be hoped that the day will soon come when it will again be possible to hold international gatherings, and to propose toasts similar to those given at the meeting of the American Institute of Electrical Engineers in 1901. On that occasion homage was paid to science in France, England, Germany, Italy and the United States by the toasts: "The land of Ampère; the country of Faraday; the successors of Ohm; the heirs of Volta and the legatees of Franklin".

Though the question of nationality cannot be said to be of capital importance, yet there is an urge to delve into the ancestry and early environment of notable men, and to attempt to trace the things which have influenced their careers. Nationality, of course, may be inherited or acquired. Usually the place of birth and ancestry conspire together to determine nationality, but sometimes place of birth has little to do with it. Cavendish was born at Nice, Black at Bordeaux, Lagrange at Turin, and Regnault at Aix la Chapelle, but everyone knows the first two were British and the other two French. All the early American men of science such as the Winthrops, Cotton Mather, Rittenhouse and Franklin were originally British subjects. Since, through the Revolution, Rittenhouse and Franklin became citizens of the United States, there has been a constant flow of men from many European countries across the Atlantic who have willingly abandoned their old nationality for a new. Graham Bell was born in Scotland, Elihu Thomson in England, Michelson and Berliner in Germany, Agassiz in Switzerland.

In most cases, there is no doubt about a man's nationality, but as has recently been seen in the discussion about Copernicus, the matter is sometimes complicated by various circumstances. On the occasion of the quatercentenary of Copernicus *The Times* wrote: "The middle of a great war between Poland and Germany is not perhaps the most suitable occasion for reviving an ancient controversy as to his nationality", and though Copernicus was born at Thorn, "the troubled history of that corner of Europe makes it difficult to speak with any certainty about his ancestry". There are many other corners of Europe with troubled histories—Alsace, Finland, Schleswig-Holstein and the various countries which made up the old Austro-Hungarian Empire. Many men have been good Austrians without a drop of Austrian blood in their veins. The great geologist Eduard Suess (1831–1914) was the son of a German merchant and was born in London. For nearly seventy years he lived in Vienna; but he retained his affection for England, which he called his 'native land'. When in 1929 a tablet was unveiled on No. 4, Duncan Terrace, Islington, London, his birthplace, Prof. J. W. Gregory said that "he made the higher study of geology international and thereby encouraged the growth of the international spirit". Another name famous in Austrian scientific circles was Littrow. Joseph Johann Littrow (1787–1840) and his son Karl

Ludwig Littrow (1811–77) were both directors of the Vienna Observatory. The elder of the two was born and educated in Bohemia, and in 1810 went to Kasan, Russia, where the younger was born. The famous naturalist Johann Gregor Mendel (1822–84) was always an Austrian subject, but his birthplace was the Silesian village of Heinzendorf, and his work on heredity was done at the old monastery at Brünn, Moravia. Ignaz von Born (1742–91), who was in the first rank of European mineralogists, and a councillor of state at Vienna, was a native of Carlsburg, Transylvania, now a part of Rumania.

That troubled corner of Europe, Alsace, now again in German occupation, belonged to France for nearly two centuries before it was annexed by Germany in 1871, only to become French again after the War of 1914–18. It has given a long line of distinguished men to France. Strasbourg was the birthplace of the chemists Wurtz, Schutzenberger, Friedel and Gerhardt. Pasteur once held a chair in its University and his statue was erected there. Other men of science have come from Colmar and Mulhouse, nearly all of them of French nationality. Another 'corner' of Europe—Holstein—was the birthplace of the astronomer, F. G. W. Struve (1793–1864). The Struve family is sometimes spoken of as German, but the astronomer was the son of a Danish schoolmaster and was born at Altona, a city which had been Danish for a century and a half. By their work at Dorpat and Pulkova, Struve and his son became subjects of the Russian Tsars and also great international figures.

Of all countries, with the exception of the United States, none has benefited more by the labours of men of science of foreign birth than Great Britain. To-day, history is only repeating itself, for our love of liberty and our free institutions have again and again made our land a sanctuary for men fleeing from religious or political persecution. When Louis XIV, by the Revocation of the Edict of Nantes in 1685, drove half a million of his most industrious subjects to seek asylum abroad, many of them came to England. To this we owe the Dollond, Demainbray and Desagulier families, all known in the history of science—the Dollonds for their optical work, the Demainbrays for their labours as the King's astronomers at Kew, and the Desaguliers, father and son, for their respective studies in natural philosophy and gunnery. With the Dollonds also came Abraham Demoivre, the mathematician and close friend of Newton. The accession of George I naturally led to closer relations between England and the Continent, and from Germany to Great Britain came Dillenius, the professor of botany at Oxford, John Müller, the first headmaster of the Royal Military Academy, Woolwich, and the most famous of all British astronomers, William Herschel. From Sweden came Solander, keeper of natural history in the British Museum ; from Italy, Cavallo, the electrician ; from Holland, Ingenhousz, physician and physicist ; and from Switzerland, Dr. Marcet, whose wife, Mrs. Marcet, a Swiss woman wrote the book on chemistry which stimulated Faraday. Another native of Geneva resident in England was Deluc, the geologist and meteorologist, and it may be recalled that W. T. Brande, the colleague of Faraday at the Royal Institution, was the son of a Hanoverian medical man. There are many other names inscribed in the history of science in Britain, like those of Rücker, Meldola, Sabine, Kater, Negretti and Siemens, which remind us of our debt to other nations.

Another chapter in the relations of Great Britain with Germany opened with the marriage of Queen Victoria and Prince Albert. It was largely due to the Prince and Sir James Clark, the Court physician, that the Royal College of Chemistry was opened in 1845 with Hofmann at its head. Three years previously, Liebig, accompanied by Dean Buckland and Lyon Playfair, had made a sort of triumphal tour through England. Playfair had studied under Liebig at Giessen and from that time onwards British students of science flocked to Giessen, to Göttingen, to Heidelberg and so on, to sit at the feet of Wöhler, Bunsen, Kirchhoff and other famous teachers. Tyndall, Frankland, Muspratt, Gilbert, Williamson, Gladstone, Sylvanus Thompson, Perkin, Smithells, Roscoe and Ramsay are a few of the distinguished men who worked in German laboratories. From Germany, too, came Voelcker, Dupré, Sprengel, Hugo Müller, Ludwig Mond, Messel, Dittmar, Schorlemmer and many besides to teach or engage in industry in Great Britain. The remarkable comradeship which existed between Continental and British chemists in the time of Victoria is fully shown in the series of memorial lectures delivered to the Chemical Society.

Though there is no question that Great Britain, and the British Empire also, have benefited greatly by the labours of men of foreign nationality, the debt has been by no means one-sided. As British chemistry students went to Germany, so foreign students came to England to learn engineering and shipbuilding. Mechanical engineering in Sweden, Russia, Italy and Switzerland owes much to such as Owen, Baird, Guppy and Charles Brown. It was William Wilkinson who erected the first blast furnaces at Le Creusot, and from the original works of Philip Taylor sprang the Forges et Chantiers de la Méditerranée near Toulon. One of the makers of modern Hamburg was the civil engineer William Lindley, whose son, Sir W. H. Lindley designed public works for Frankfort, Budapest, Baku and other places. At one time there was a British engineer in every port in the world from Tokyo to Buenos Aires.

All these facts go to show that there can be no such thing as isolation in scientific matters. In March 1942 Sir Henry Dale, in a letter to *The Times* about the tercentenary of Newton, said that his achievement in science is the heritage of all men. This applies equally to every scientific inquirer, from the most brilliant genius to the humblest of those who endeavour to increase natural knowledge ; and in honouring such men as Kepler, Galileo, Harvey, Swammerdam, Berzelius, Newcomb, Fresnel, or Pavlov, we pay homage to the great band of seekers after truth wherever they were born or whatever their nationality.

PROLEGOMENA TO PLANNING

Creative Demobilisation

(International Library of Sociology and Social Reconstruction.) Vol. 1: Principles of National Planning. By E. A. Gutkind. Pp. xvi+331. 21*s.* net. Vol. 2: Case Studies in National Planning. Edited by E. A. Gutkind. Pp. viii+280. 21*s.* net. (London: Kegan Paul and Co., Ltd., 1943.)

ALLIED successes in the autumn of 1942 were immediately reflected in Great Britain in the new focus of attention towards post-war programmes and policies. The warm welcome of the Beveridge Report was in large measure attributable to its timely appearance. Since then dozens of plans for agriculture, for particular industries, for special areas and for bombed cities have appeared. Yet it is remarkable that there have appeared only two works which discuss comprehensively the objectives and principles of planning. Prof. Hutt diagnoses pre-war trends and practices in his "Plan for Reconstruction" and outlines a consistent post-war economic policy for Britain which, he believes, removes the major defects that have hitherto marred a smooth working of economic forces. The second work is that by Dr. Gutkind, who establishes the general principles of town and country planning, and applies them to Britain. It would be instructive to examine the common features of these two essays, both of which are published in the International Library of Sociology and Social Reconstruction. Here, however, we can simply note the sense of urgency with which both authors write. Dr. Gutkind believes that "failure to identify the demobilisation with a creative beginning of a new era will be tantamount to a new declaration of war". The unpreparedness for peace shocks him, yet he will have none of hand-to-mouth policies. From the armistice we must concentrate our whole might on the "goal of making Britain one good house"; and this attitude helps to explain the author's impatience with possible criticisms of his approach, and his contempt for *laisser faire.*

The first volume, of which Dr. Gutkind is author (of the second he is editor), states that the foremost objective of town and country planning is the creation of an inspiring and diversified environment. With this few reasonable men will quarrel, but that general agreement is likely to evaporate when the general principles the author formulates come to be applied. The chief of these principles is the decentralization and dispersal of settlement. We are told "Decentralisation should be understood not in the narrower sense of decentralisation of industry but in its broader meaning of decentralisation of settlement—the loosening up of too densely populated urban districts by the development of new, or by the further development of existing, places within the direct sphere of influence of the urban centre which is to be re-developed. Dispersal, on the other hand, can be defined as the same process but spreading beyond the confines of the area from which the overflow is to be drained" (p. 219). The fundamental aim of pursuing a national plan which embodies these principles is the fashioning of the environment of man according to his social needs as a free individual. This involves the establishment of a sound balance between the four functions—housing, working, distributing and recreating—which constitute our being. This functional division is analogous to the division, made by the classical economists, of the productive process into production, exchange, distribution and consumption, and the use of this analogy might have facilitated the exposition of the idea of a 'balance'. The notion of a balance of these functions is Dr. Gutkind's yardstick, which is applied in successive chapters to British agriculture and industry.

In Great Britain to-day more muddled thinking is devoted to the ills and future of agriculture than to any other topic, with the possible exception of finance. What happens when Dr. Gutkind applies his principles? They lead him to identify himself wholeheartedly with the school of thought which has found its most recent expression in the majority report of the Scott Committee on Land Utilisation in Rural Areas. "Agriculture", says the writer (p. 123), "must be accepted as a basic industry, and its fundamental function in the national economy must govern its development—neither charity nor antiquarian æsthetics are a sufficient basis for an agrarian policy." But what is the sufficient basis?

Although the nineteenth century belief in cheap food might have gone too far and suffered from a measure of shortsightedness, it was not without some solid justification both from the national and international points of view. Freedom from want cannot be comfortably maintained if every national area adopts autarchic agrarian policies on social grounds. The legacy of fear and distrust left by the War of 1914–18 and the Great Depression will not be thrown off, much less the fuller life be attained, by such policies. The limits of Britain's ability in this direction without multiplying costs many-fold have been revealed in two major wars. Similarly, in respect of industry Dr. Gutkind's criticisms of past trends are somewhat immoderate. In spite of the tendency of socialist thought in Britain and industrial methods in the U.S.S.R., Dr. Gutkind maintains (p. 209) that "A further argument in favour of decentralised and scientifically run industrial units is the reduction of competitive conditions; that is important as it tends to eliminate the race for 'a place in the sun', that is, it reduces the agglomeration of industry within one region which might, as it actually has done, offer some alleged advantages over competitors who remain outside this particular region". Would he countenance pseudo-competition?

With the aid of diagrams a plan for the physical transformation of town and country is unfolded. Here the author's views agree with those of Lewis Mumford. Three stages of action are suggested in order to accomplish the functional plan: first, the splitting up of the whole congested area into sections by a system of linear arteries, thus producing the primary grid of green belts and roads which permits of recreating and distributing; secondly, the differentiation of these sections among the main categories of use by a system of spatial zoning which creates an organism of residential and non-residential districts for housing and working; and, thirdly, the further subdivision of these units by a system of 'functional spotting' which leads to a secondary grid of open spaces and streets. In this way a functional balance is gained. The scheme is ably evolved.

In the second volume the twenty-two separate memoranda are grouped similarly to the main chapters of Vol. 1. Profs. A. W. Ashby, J. H. Jones and A. G. Ogilvie, and Messrs. E. G. Bowen and J. R. Currie are among the contributors. All future workers in this field will be grateful to Dr. Gutkind for bringing together such an array of facts and views as we find here; and there is a need for further work. Dr. Gutkind has not said the last word on the principles of national planning. He has made a useful, provocative beginning, and not sought finality.

D. J. MORGAN.

HOMES AND INCOME

(1) An Enquiry into People's Homes

A Report prepared by Mass-Observation for the Advertising Service Guild. ("Change" Wartime Surveys, No. 4.) Pp. xxiv+228. (London: John Murray, 1943.) 10*s*.

(2) War-time Pattern of Saving and Spending

By Charles Madge. (National Institute of Economic and Social Research, Occasional Papers, 4.) Pp. viii+140. (Cambridge: At the University Press, 1943.) 6*s*. net.

(1) ALL but the least observant would agree that the war motive that governs the actions of the people of Great Britain is not only to defeat the common enemy but also to create by exertion and example a nobler Britain and a happier world. This report has been prepared by Mass Observation for the Advertising Service Guild as a contribution to the responsible task of rebuilding a better Britain; with its publication these two bodies have earned the gratitude of every man of goodwill.

The merit of this inquiry into housing conditions and services is that it was undertaken at the level with which post-war planners will have to deal if they are to see their schemes go beyond the paper stage—the level of the people. To-day we are assailed by the conviction that this is to be the age of the common man. It is fitting, therefore, that inquiry should be made into the way the common man lives and the way he would like to live. If he can see that reconstruction involves accomplishment of some of his dreams and desires, the more likely is the British citizen to continue his labours unabated during the immediate post-war period, with all its reaction from stress and strain, and build up a better ordered society.

The survey was chiefly concerned with attitudes to housing among the working classes and was carried out in eleven different places in England, starting in August 1941 and finishing in April 1942. These places were chosen to cover representative types of housing: old houses, L.C.C. estates, garden cities and flats—and, where possible, districts were selected where another social survey had been conducted by Mass Observation before the War, so that comparative pre-war data should be available. In 90 per cent of the cases the people interviewed were housewives; whether this was expedient or from choice the report does not make clear. Important age and sex differences between those interviewed are carefully analysed, while the entire sample was almost evenly divided between the two working-class grades, skilled workers or artisans, and unskilled workers. The results of the survey are comprehensively recorded and will amply repay close study by architects, sociologists, politicians, town-planners, civil servants, etc.

Almost all the features that go to the making of a happy home have been considered and are too numerous to be considered separately here. The following are among the more important of the general observations that arose as a result of the inquiry. The needs and wants of the people are so varied that it will be impossible to satisfy everyone. On the whole, people are attached to their present homes and, although they grumble, would be prepared to make the best of a bad job if the glaring faults of their houses were put right. In many cases, the addition of a bathroom or a hot-water system would be enough to make the householder contented with her lot, while an extra cupboard in the kitchen or a modern labour-saving range instead of the old-fashioned coal ranges would be enough to satisfy other people.

The houses-versus-flats controversy is given the blow which should knock it out as the favourite artificially introduced subject for discussion groups. The mass of the people still prefer to live in a small house or bungalow with a garden; the garden city or housing estate has particular appeal. "Yet good and well-built flats, near people's work place, are suitable for some, and are appreciated particularly if they incorporate amenities such as constant hot water, lifts and playgrounds for children. At present, the choice is usually between a house and a garden a long way away from the work place and a flat reasonably near work. If people could, without having long journeys to work, live in a house of their own, the majority would infinitely prefer it."

Another point that needs scrutiny is that the younger people tend to be much more discontented with their lot than older people, while nutritionists will not be surprised to read that people are very reluctant to alter their feeding habits even in the face of acute food shortage.

The most disquieting feature of the report is an observation which is revealed indirectly rather than as answers to leading questions. In attempting to find out how much people liked the neighbourhood in which they live, the interviewers were astonished to find that "less than one person in a hundred mentioned any activity that involved co-operation with their fellow-citizens. The idea of living in a neighbourhood thus appears to have virtually no connection with any responsibility for its good government in the mind of the average housewife. There was no single reference to political activities, practically none to any local authority except in so far as it was a landlord and only a few to various forms of social, cultural and religious activity." If we accept the idea that the basis of democracy lies in the mutual responsibility of a community and all the individuals composing it, it would appear that we have a long road to travel before the idea is put into practice in Great Britain.

(2) Mr. Madge's book deals with an inquiry made into the way that spending and saving have changed during the War. The methods used were similar to those adopted by Mass Observation, but differed from them in the use of a much smaller team of interviewers. Surveys were carried out in the cities of Bristol, Glasgow and Leeds, additional material being provided by the actuary of the Aberdeen Savings Bank.

The investigation began as an attempt to find out how much of their income was being saved by wage-earner families by asking a random sample of them a number of direct questions about their savings. Because of tendencies to conceal some forms of saving from the questioner, the results proved unsatisfactory.

The inquiry was then extended to obtain particulars of spending as well as saving. It was thus possible to see whether the account given balanced with what was known of the family income.

The interviewing was carried out in an extremely thorough manner, and eventually reached a high point of efficiency. Of special interest in the general conclusions is one observation which keeps obtruding itself. While saving was shown to vary greatly among individuals, it became clear that a large proportion of wage-earners' savings are due to a small proportion of wage-earners. It is evident that, after the War, this must mean that the small proportion of wage-earners with a strong propensity to save will emerge as a special group with special interests, considerably richer than their fellows. This group, which has been steadily increasing during the past fifty years, is likely to develop even greater political significance in the future.

Another interesting conclusion which is presented in the report is that the average husband keeps roughly a quarter of his earnings as pocket money. The retention of such a large share of his earnings may be due to the husband's desire to indulge his own psychological inclinations towards the act of spending.

The report is rounded off by two appendixes, which have been prepared by Erwin Rothbarth. One contains a note on a method of determining income for families of different composition and the second an estimate of national savings per family and the relation of saving to income and excess income. They add to the value of a report which would still be of great value without them. Mr. Madge and his team are to be congratulated on an admirably executed investigation in the difficult field of social economics. T. H. HAWKINS.

MICROBIOLOGY OF THE AIR

Aerobiology

Edited by Forest Ray Moulton. (Publication of the American Association for the Advancement of Science, No. 17.) Pp. x+289. (Washington, D.C.: American Association for the Advancement of Science, 1942.) n.p.

ALTHOUGH it is fully sixty years since the classic work of Tyndall and of Miquel on air-borne micro-organisms and twenty-five years since Molisch coined the word 'aeroplankton', this is the first book in any language which attempts to deal with the microbiology of the air in any comprehensive way; and this in spite of the intensive interest in every aspect of atmospheric study which the development of aviation has created.

It is the outcome of a symposium at a meeting of the American Association for the Advancement of Science, held in September 1941, organized by the Section of Medical Sciences of the Association, and it clearly bears the imprint of its medical origin. Among the fifty-five contributors no fewer than thirty-eight are either medical men or else represent medical institutions, and twenty-eight out of the thirty-seven papers included deal with either air-borne infection or with aerial allergens. This seems to mark a significant swing back towards the view of the early antiseptic surgeons and the Flugge school, to whom air-borne infection seemed all-important, but it is a return well guarded by a stricter ascertainment of facts and by their more precise application.

No one can overlook the importance of the medical aspects of aerobiology. Sir Leonard Hill has said that man has learned by painful experience to safeguard the purity of his food and of his drink, but has still to learn to take the same precautions for the air he breathes. Yet it must be admitted that the strong medical bias of the book detracts somewhat from its general scientific consequence. There are so many purely scientific problems left aside in favour of special medical topics. For example, the methods of killing air organisms loom so largely in the contents that one is tempted to make the rude suggestion that "Aeronecrology" might have been a better title.

If this is, therefore, not quite the book for which the scattered workers in this field have hoped, if it falls a little short of epoch-making, it is nevertheless a very considerable work. Its importance lies in its value as a summary and review as well as in the new information presented. Naturally, recent American work is most fully covered, but earlier European work is somewhat imperfectly recognized and not always correctly. It is not true to say, for example, that high-altitude collections were first made by aeroplane. Christiani, Flemming and Martin Hahn all made extensive collections from free balloons before the day of the aeroplane.

We have still a very imperfect idea of the aerial flora. There has been a vast deal of ingenuity expended on devices for the capture of aerial organisms, but there is as yet no wholly satisfactory, quantitative instrument for that purpose. Electrostatic precipitation may be 100 per cent physically efficient, but it is very difficult to apply in the field and it seems to kill the organisms precipitated. No washing or filtration method is anything like perfect, and even the impingement or the centrifugal methods, which are probably the best at our disposal, are each deficient in some particular. This may explain why so much reliance is still placed upon primitive deposition methods with agar plates, but it does not excuse us for trying to found quantitative conclusions upon such demonstrably faulty practice.

The results of air collections have hitherto been too often stultified by another factor, namely, very limited conditions of culture. Beef or malt agar at 37° C. or 25° C. represent almost the whole range of conditions employed, and there is a total lack of statistically controlled analysis of variance with medium, time and temperature, such as the soil bacteriologists have used. This is a general criticism but it is not without a present application.

It need scarcely be said, therefore, that our knowledge of specific distribution, association and bionomics is well-nigh nothing. With few exceptions the ecological outlook on air problems is missing both in the present work and elsewhere. The aeroplankton as a whole is treated as temporary, like the pollen grains and the fungal spores, and the air is viewed simply as an agent of transport, even for the bacteria and yeasts. "Dust to dust" seems to be the only cycle envisaged. Yet the experiments of Trillat and others show at least the possibility that the air may be a vegetative habitat, and the large proportion of non-spore-formers present, which anyone may easily verify, needs more than a conventional explanation, unless we are to go back to the idea of 'germs', in the original Tyndallian sense.

The material in the book is treated under two main headings: "Extramural" and "Intramural".

Under the first heading, Stakman gives a survey of air-transport problems. Wodehouse provides some fine and useful plates of pollen forms and Durham treats of mould spores as allergens. Proctor and Parker give a summary of the work, mainly by the former, on high altitude collecting. ZoBell gives some interesting new information on bacteria in marine air, emphasizing the overlooked condition of halophily prevalent among them and incidentally putting an end to the myth of the sterility of oceanic air masses, on which the belief in the terriginous origin of all aeroplankton largely rests.

Keitt and Christensen give good reviews of local and distant transportation of plant pathogens. Lastly, Glick's account of the admirable aeroplane studies of insect distribution, under the care of the U.S. Department of Agriculture, whet the appetite for more facts about this infant science, which may become of such immense significance in the aerial age before us.

Under the heading of "Intramural", Wells and Wells introduce the papers included as laying the foundation of a general theory of air-borne infection. The series is comprehensively planned. It covers first the physics of microscopic particles in air suspension (Hatch, Jennison and Phelps). Secondly, there are fifteen papers on air disinfection, treating particularly of ultra-violet radiation in many aspects. Thirdly, there are six papers on the environmental control of air infection both for adults and infants and four papers of observations on the actual passage of air-borne infectants. Finally, there are two papers on the use of aerosol mists as disinfectants. The relative simplicity and effectiveness of this method, especially with propylene glycol, entitles it to greater prominence.

Incidentally, British readers will be interested in the revelation that very large stocks of cellulose acetate masks have been prepared in Great Britain for issue as safeguards in the event of serious shelter epidemics appearing. Happily they have not been needed.

Notwithstanding the regrets which have been expressed that a more all-round treatment of the subject has not been possible, the reviewer would pay high tribute to the workers concerned in producing this attractive and important book. Such an amount of modern work has here been brought together and reviewed by first-hand authorities that it is quite indispensable to all who are interested in the microbiology of the atmosphere. We may well end by submerging criticism in admiration.

R. C. McLEAN.

AMERICAN TIMBERS

Commercial Timbers of the United States

Their Structure, Identification, Properties and Uses. Published formerly under the title "Identification of the Commercial Timbers of the United States". By Prof. H. P. Brown and Prof. A. J. Panshin. (American Forestry Series.) Pp. xxi+554. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 35s.

A MORE suitable title for this book than that selected by the authors would have been "A Treatise on Wood Growth and Structure". The reader will find that out of 554 pages only 154 can be said to be informative on the subject of commercial timbers of the United States: these 154 pages include seventy-five kinds of woods, on which the information is limited and generally highly technical. The uses of the timbers named are drawn only from information within the United States, and a glance at the bibliography displays perhaps a somewhat insufficient research.

A treatise on the commercial timbers of the United States should not neglect the commercial aspect. The highly organized methods employed by American commercial men have played an important part in the export trade to every part of the world. The total import into the United Kingdom alone for the year 1938 amounted to no less than £3,672,747, and of oak alone to 5,841,395 feet cube, valued at £1,038,839—by no means a negligible matter.

American timbers will be met with all over the globe. The traveller in India and Burma may find himself in a railway carriage lined with American timber, and even in the most remote districts of Burma housewives may be seen using domestic articles made from American woods. None of these interests, however, is mentioned in the work before us. From a commercial point of view, therefore, the reader is left unsatisfied.

There seems to be a certain lack of clarity as to the aim of the book. In the introduction Mr. Walter Mulford says: "The American Forestry Series is intended for the college student, the practising forester, and men in the forest industries", and in a somewhat confusing manner he informs the public that "Forestry is a profession", modified later by a further statement that it "is not an exact profession", and again that "Forestry is not a science", summing up that "The American Forestry Series is to be professional in character, with as much sound science as it is possible to include". The distinction between a "profession" and an "exact profession" is difficult to understand, as also what is meant by "sound science". The claim that "Forestry is not a science" might be open to dispute. Nature has provided a wealth of forests for the enjoyment and use of mankind, and for the necessary health and safeguard of climate and soil, but this is so far as the natural forest carries us. It is clear that the science of controlling and perfecting the man-made forest has become a necessity as a result of the demands of civilization; but while the problem is interesting, the subject is beyond the scope of the present work.

Attention having been directed to certain matters in which the book fails to supply information that might well be expected, it is pleasant to be able to commend many merits which it does undoubtedly possess.

When we come to the subject of wood growth and structure, quality and texture, the origin of wood, its gross features, its woody plant cells, minute structure, and miscellaneous information, the authors are at home, and have contributed an excellent treatise for the instruction of the forest student and the ordinary reader. Two hundred and ninety pages are devoted to these subjects, presented in clear and concise terms, and fully illustrated by two hundred and twenty photomicrographs and forty-eight plates, which include representations of the timbers as they are severally constructed and as they appear when adapted to domestic use.

ALEXANDER L. HOWARD.

Elementary Structural Analysis and Design

Steel, Timber and Reinforced Concrete. By Dr. Linton E. Grinter. Pp. xiii+383. (New York: The Macmillan Company, 1942.) 18*s*. net.

THEORY of structures is, by general consent, a necessary subject in the curriculum of the engineering student; there is, however, considerable divergence of opinion as to the extent to which it should be supplemented by the study of design. The reason is clear: successful design calls for far more than the student can acquire within the university. There is, however, real value in giving him some training in the technique of design, and Dr. Grinter is to be congratulated on the admirable way he has presented this difficult subject.

Only the simplest basic theory is used; for example, redundant structures are reduced to statically soluble cases by suitable simplifications, and the actual numerical calculations are, therefore, easy. One of the most attractive features is the series of design sheets which so fully illustrate the book and which teach the student, by example, the importance of a logical and neat lay-out of calculations. The contents include excellent chapters on welded construction and on construction in timber, in addition to the more usual subjects.

The author naturally deals with American practice, and in a few instances the British student will observe differences; for example, a reversal of the conventional signs for bending moments and shearing forces and the fact that the Perry-Robertson strut formula, so widely used in Britain, is replaced by the secant formula. These and differences in detail design, however, add to the interest.

The book is clearly and attractively written and can be thoroughly recommended to any student as complementary to his study of theoretical structures. He is difficult to please if he does not read it with enjoyment as well as benefit.

A. J. S. PIPPARD.

An Introduction to the Modern Theory of Valency

By Dr. J. C. Speakman. Second edition. Pp. 159. (London: Edward Arnold and Co., 1943.) 5*s*. 6*d*. net.

IN this book the author conducts his readers carefully and pleasantly through the complex maze of valency problems. Particularly valuable, in the reviewer's opinion, is the discussion of polar and nonpolar compounds in Chapter 9 in terms of characteristic properties like dielectric constants, association and so forth. A very fair and reasonable balance is held between the views of the leading authorities, and thus the student is encouraged to use his analytic and critical faculties as his own knowledge progresses.

So far so good. But the fact has to be faced sooner or later (and that it is not faced here and now is by no means Dr. Speakman's fault) that a real comprehension of the *modern theory* of valency demands mathematical ability and equipment of an order probably altogether different from that envisaged in the average physico-chemical laboratory. It is thus just worth pondering whether 'descriptive' books on the subject are wholly justified these days. If they are, the present one is an excellent example of what can be done. On the other hand, there seems a certain awareness in these pages that all is not plain sailing: maybe a mathematical appendix to help bridge the gap and point out the heights beyond might remove some heart-searchings on this score.

F. IAN G. RAWLINS.

School Physics

By T. M. Yarwood. Part I. Pp. xii+366. (London: Macmillan and Co., Ltd., 1943.) 5*s*.

THIS book contains the work for the first two years of a four-year concentric course in physics up to School Certificate standard. The remaining two years' work is to be dealt with in a second volume.

Although there are many books already available which fulfil the same purpose, this one will have a good reception. There is nothing new in the presentation of the principles; its difference lies in the many descriptions of modern appliances and the references to the applications of physics in everyday life. Many of these are too complicated for the younger boy but, as the author points out, much can be omitted from the first reading and left until the School Certificate year, when both Parts I and II should be used.

The book is attractive. It is well set out and has an abundance of good diagrams. The modern applications will appeal to the boy and, what is of paramount importance, attract him to read the book out-of-school. There are many references to aeronautics, and war-time publication is marked by the inclusion of descriptions of modern creations such as the barrage balloon.

The style is good, but a boy of eleven may find the language a little too difficult. The examples, which are collected at the back, are not very numerous but nevertheless sufficient. It is disappointing that the few extra topics required for the physics section of the General Science syllabus are not included, for, with such additions, the book would have the much wider appeal it justly deserves.

On Pseudohypertrophic and Allied Types of Progressive Muscular Dystrophy

By Julia Bell. (Being Part 4 of Vol. 4, "Nervous Diseases and Muscular Dystrophies", of "The Treasury of Human Inheritance".) Pp. iv+283–342+plates 33–44. (Cambridge: At the University Press, 1943.) 12*s*. 6*d*. net.

DR. JULIA BELL has contributed a useful monograph on muscular dystrophy in man to "The Treasury of Human Inheritance" series. Clinical and genetical data from more than 1,300 individuals exhibiting this distressing abnormality are analysed in regard to mode of inheritance, prognosis, symptoms, fertility and time of onset. She divides the clinical types into three groups but points out that intergrading may occur. Each group on the whole persists in one family and is partly related to one of three genes which behave as dominant, recessive or sex-linked respectively. Several problems relating to development and transmission of the abnormality are discussed.

Dr. Bell points out that if 140 individuals had abstained from parenthood, there would have been a reduction of 468 dystrophic and 1,195 apparently normal individuals. Of these the members of the dominant gene group live long and may produce a proportionately large number of dystrophic and normal non-carrier individuals, while the affected members of the sex-linked group have a short life and will not affect the future generations to any great extent. The publication of such analytical résumés as this by Dr. Bell is of great value to science and medicine.

F. W. SANSOME.

PHOTOGRAPHIC ANALYSIS OF MOTION*

By E. R. DAVIES

Kodak Research Laboratories

TO-DAY we turn naturally to photography to analyse movements which are too rapid for our eyes to follow. If we tend to take this powerful weapon too much for granted, it must be remembered that there were formidable experimental difficulties facing the investigator before the advent of photography. Marey, while director of the Physiological Station in Paris, devised a most ingenious way of studying the movements of a horse. Pressure chambers fitted to the underside of the horse's hooves were connected by pneumatic tubes to a recording mechanism held by the rider, which registered the time of duration of contact of each hoof with the ground. Marey did much painstaking work along these lines between 1860 and 1880.

Muybridge, a native of Kingston-on-Thames, was conducting a photographic survey of the Californian coast in 1872 when he was appealed to by Governor Sandford to settle a controversy which was raging in San Francisco and which was aroused by Marey's analysis of the movements of a horse. The question was whether a trotting horse ever had all its feet free of the ground simultaneously. Muybridge set himself the task of obtaining photographic proof and achieved immediate success. He used a camera fitted with what may be loosely described as an instantaneous shutter and, taking photographs at random, soon obtained one which showed all the horse's feet free from the ground. The controversy was settled; but, more important, the direction of Muybridge's life's work was settled also.

For the exhaustive investigation of animal locomotion, upon which he soon embarked, Muybridge erected an elaborate apparatus on the racecourse at Palo Alto, near San Francisco. A battery of twenty-four cameras was arranged along one side of the track. Across the track was stretched a number of threads each connected to the shutter on one of the twenty-four cameras. The camera shutter was in the form of a guillotine urged downwards by a spring, and was released by an electro-magnetic relay on the breaking of the thread. In this way, as the horse passed in front of the cameras, it broke the threads in succession, and a series of instantaneous photographs was obtained. The time of exposure given by the shutters was of the order of 1/1,000 sec., and it is remarkable that Muybridge was able to obtain sufficient exposure with the photographic materials available to him. This was the time of the wet-plate process, and, compared with modern practice, photography was laborious in the extreme. To obtain sufficient exposure, Muybridge arranged a sloping white background to catch the light of the sun. Against this the horse stood out in sharp relief. Even so, his early results were mere silhouettes lacking all detail. With the increasing use of the gelatin dry plate (invented by Maddox in 1871), the photographic process was greatly simplified, and the sensitivity to light was increased many times. In his later work, Muybridge was thus enabled to obtain photographs showing detail. An impression of the scale of his operations will be gained from the statement that he exposed no fewer than 100,000 plates in the two years, 1884 and 1885.

Muybridge showed how the pictures taken successively by his battery of cameras could be combined to reproduce the appearance of the original movements. He printed his negatives in order on a band of paper. One of his original records was presented to the Royal Institution following the discourse he gave in 1882. The record, which is still preserved at the Institution, is placed in an apparatus known as a zoetrope, which is simply an empty cylinder with vertical slots arranged at equal intervals around the circumference, and it is carried on a vertical axis. On rotating the cylinder the pictures are viewed in succession through the slots and appear to be in motion. Muybridge thus raised a toy of the Victorian drawing-room to the status of a scientific instrument, and used it to demonstrate the correctness of his method of photographic analysis. The zoetrope, and other improved designs for which he was responsible, may be rightly regarded as forerunners of the modern cinematograph projector.

The cinematograph projector and camera were brought a stage closer by Marey, who, in his chronograph, employed a band of film on which successive photographs were taken, and who devised another apparatus for viewing the results by projection on a screen. Marey was a most remarkable man. I have already mentioned his work with pressure chambers and pneumatic tubes. Introduced to the photographic method by Muybridge, he was quick to seize upon its possibilities. His book "Le Mouvement" (published in 1894) reveals him as a brilliant experimentalist. His investigations covered the analysis of the locomotion of many animals, of birds in flight, of insects and even of micro-organisms by means of photography under the microscope. Few developments in high-speed photography were not visualized, and in some part realized, by him.

As typical of his work, I will single out for mention one technique which has proved of lasting value. Marey built a camera in which the shutter was a disk with radial slots. This revolved in front of the camera lens and caused a series of photographs to be taken in rapid succession on the same plate. In place of Muybridge's brilliantly lit background against which the moving object was revealed as a silhouette, Marey used a black background and whitened his object. In this way only the object (and not the background) was recorded during the successive exposures of the plate.

Marey's rotating disk shutter with its radial slots gave individual exposures of about 1/25,000 sec. This was an advance on Muybridge's shutter time of 1/1,000 sec., but is nevertheless far too long a time for many purposes. Mechanical shutters of any type have obvious limitations due to the inertia of the moving parts. But the problem can be approached from a different angle. It will be obvious that the desired result will be obtained if the camera shutter is left open and the subject illuminated instantaneously. Light flashes can be obtained of extremely short duration, and their use in 'stopping' rapid motion represents a milestone in the road of progress.

Lord Rayleigh used magnesium powder for a slow flash, and the electric spark for a fast flash with a time of duration of the order of one millionth of a second. With this he was successful in photographing a soap film in the act of disrupting—a phenomenon that takes place with extreme rapidity.

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* Substance of a Friday discourse delivered at the Royal Institution on December 11, 1942.

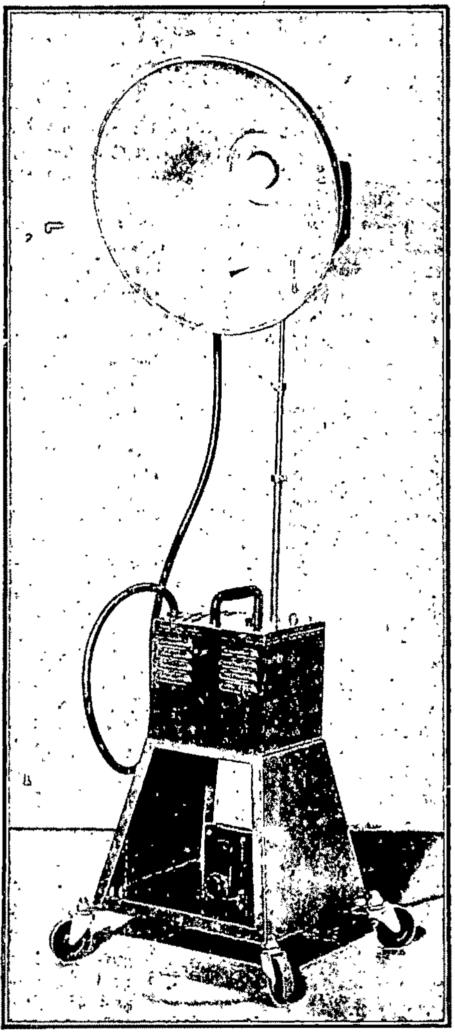

Fig. 1. KODATRON SPEED LAMP.

Prior to this time Worthington had used the electric spark in his beautiful experiments on the formation of drops and the mechanism of splashes[*]. His early work was not photographic. He observed different phases of the splash made apparently stationary by the light of the flash, and sketched what he saw. For his later investigations on surface tension phenomena he used photography.

The electric spark is fast enough to permit the photography of projectiles in flight. Sir Charles Boys took such photographs around 1890. They were shadow photographs; no camera or lens was used. The bullet passed between the photographic plate and the spark, and thus cast the shadow. In front of the plate, and in the line of flight, were two wires forming a gap in series with the spark gap. As the bullet bridged the gap, the fall in the resistance of the circuit caused the spark to pass and the photograph was obtained. Many associated phenomena are clearly revealed in such photographs. The nose of the bullet forms a bow wave. This travels with the speed of sound in air, about 1,100 ft./sec., and Boys showed how the speed of the bullet can be calculated from the angle between the bow wave and the line of flight. The bullet, though travelling at more than twice the speed of sound, is revealed with extreme sharpness by the spark, which lasts for less than one millionth of a second. Boys succeeded in measuring the duration of his spark by reflecting it on to a photographic plate by a rapidly revolving mirror and measuring the length of the trace—a method which we still use to-day.

Boys' projectile photographs bear comparison with the most modern work. The chief difference seen in the beautiful photographs published by Quayle of the Bureau of Standards in 1925 is the absence of the synchronizing wires. Quayle fired his spark by means of a microphone actuated by the noise of the explosion. This method was suggested by Dr. Mach of Vienna, whose father, Prof. Mach of Prague, was the first to obtain photographs of bullets in 1881. Mach, however, was not able to realize this method of synchronization with the apparatus available to him.

So much for the early history of the subject. By the turn of the century the principles of photographic analysis of motion were well understood: the possibilities of the method were fully realized. Advance since that time is largely a story of improvements in technique: improvements in photographic materials, in light sources and, above all, in the development of the cinematograph.

As to photographic materials, it is a story of steady improvement in quality and advance in sensitivity. I thought we had nearly reached finality a few years ago; but the War has brought forth a tremendous effort, and the fastest materials to-day are several times as sensitive as they were only two or three years ago. At a guess—it is little more in the absence of precise data—I should say that since Muybridge's time we have seen an increase of at least a hundred times in the speed of photographic materials. That is to say, we can achieve similar results to-day with 1/100th of the light.

Lenses, too, have improved out of all knowledge. But here again it is difficult to give a precise figure for the effective increase in speed, for the very fast Petzval portrait lens was introduced in 1840—within a year of the invention of photography. However, it was poorly corrected, and a common aperture in those days was $f/8$. To-day $f/1 \cdot 5$ is equally common—an increase in light-gathering power of thirty times.

To turn to light sources: the spark is an admirable way of obtaining extremely short exposures, and is probably unsurpassed when exposures of less than a millionth of a second are required. Apart from projectile photography, however, such extremely short exposures are rarely needed. A large output of light is more often desirable, and the possibilities of the spark in this direction are severely limited.

Recent developments of the gas discharge tube have resulted in a much more generally useful source of light. For the cold

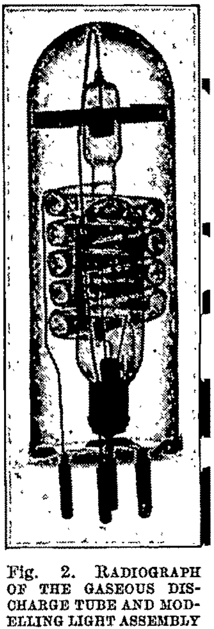

Fig. 2. RADIOGRAPH OF THE GASEOUS DISCHARGE TUBE AND MODELLING LIGHT ASSEMBLY FROM THE KODATRON SPEED LAMP. THE DISCHARGE TUBE IS WOUND ROUND THE TUNGSTEN FILAMENT LAMP WHICH IS USED FOR ARRANGING THE LIGHTING ON THE SUBJECT. NOTE (AT THE LEFT) THE TRIGGERING ELECTRODE PASSED ROUND THE COILED DISCHARGE TUBE.

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[*] Worthington, A. M., "The Splash of a Drop and Allied Phenomena" (*Proc. Roy. Inst.*, May 18, 1894): "A Study of Splashes" (London, 1908).

cathode discharge tube, which represents a most important advance, we are largely indebted to Edgerton, of the Massachusetts Institute of Technology. A commercial version of the cold cathode discharge tube is the Kodatron Speed Lamp (Figs. 1 and 2). This consists of a discharge tube wound in the form of a helix to give a compact source of light, with a frosted glass container and a reflector. The tube is filled with a mixture of rare gases at low pressure and provided with anode and cathode. The Kodatron is self-contained, with a control box in the base of the stand supporting the reflector. On connecting with the 240 volt A.C. supply and switching on, a bank of condensers is charged to 2,000 volts. Nothing happens, since the gas pressure is adjusted to withstand this potential. The tube contains, however, a third electrode and, on depressing a second switch, this conveys a high-frequency pulse to the tube. The gas is ionized; the sparking potential drops to below 2,000 volts; the current passes between the electrodes and is accompanied by a vivid flash of light. The duration of the flash depends upon the condenser capacity. Using the full capacity of 112 mfd., the flash lasts for 1/5,000 sec. Within the angle of the reflector the luminous output is of the order of 50 million candle-power; and with a fast film and high-aperture lens, photographs can be taken of objects at a distance of 100 yd. from the lamp.

As this lamp demonstrates, electronics have played their part in the advance in the design of light sources. The application of electronics has also enormously simplified the problems of synchronization. If a beam of light is caused to fall upon a photo-electric cell, the cutting of the beam can be made to fire the flash. A microphone connected with the Kodatron illustrates the principle of synchronization by sound. By varying the distance between the microphone and the source of sound, a time lag can be introduced to the extent of 1/1,000 sec. per foot. This is often convenient in projectile photography. The spark can be fired at any predetermined interval of time after the explosion and the bullet thus photographed at any required distance from the muzzle.

Dr. Slack, of the Westinghouse Laboratories, has recently devised an X-ray tube which does not contain a heated filament to provide the source of electrons. It functions in much the same way as Edgerton's cold cathode discharge tube. A burst of current through the tube causes an emission of X-rays limited in duration to a millionth of a second. Bullets can be photographed with this apparatus as they pass along the gun barrel.

So far we have been concerned for the most part with the taking of a single photograph: with snatching a fleeting instant from the passage of time to reveal one phase of an event, and with methods whereby we can ensure that we capture the instant of interest. If we wish to study the whole course of an event, we must turn to the cinematograph. In the high-speed cine-camera the pictures are taken at a much greater rate than that used for projection, and so the event is stretched out in time.

In projection at least sixteen pictures must fall on the screen in each second if flicker is to be avoided and the appearance of continuous motion is to be obtained. The modern high-speed cine-camera will take 3,000 pictures per sec. We are thus able to slow down the motion in the ratio of 3,000 to 16, a factor of about two hundred times. For this reason the high-speed cine-camera is often referred to as a 'time microscope', which, in the case I have quoted, can be said to have a 'magnification' of two hundred times.

In the ordinary cine-camera the film is moved intermittently. This is impossible at high speeds; the film must run continuously and the desired result must be produced in other ways. Edgerton overcomes the difficulty by using his discharge lamp to illuminate the subject by a succession of flashes to give the separate pictures on the continuously running film. The value of the method to modern industry will be obvious.

In industrial applications, however, it is rare that one can bring the problem to the laboratory. We need readily portable equipment, such as the Kodak High Speed camera. The subject is illuminated in the ordinary way, that is, continuously. The film also runs continuously through the focal plane of the lens. Between the lens and the film a block of glass rotates to form a shutter and to provide optical compensation for the film movement (Fig. 3). The glass block is fitted with vanes which form part of the surface of a cylinder and act as shutters. During each revolution, light from the lens is admitted to the film and a photograph is taken. The light is refracted downwards by the glass block as it passes through the vertical position in such a way that the image moves with the film and relative motion is avoided.

At a frequency of 3,000 pictures per second—the maximum speed of the camera—the time of exposure of each photograph is 1/10,000 sec. At this frequency the film is travelling at 75 ft./sec., and, were it not for the optical compensation, the exposure time would have to be reduced to a few millionths of a second to reduce the effects of film movement to negligible proportions. These conditions can be met by Edgerton's flashing lamp technique, but only with sacrifice of illumination. For the analysis of many phenomena, the most important requirement is a high frequency of picture taking: given this, the exposures of the separate pictures can be relatively long, and the ability to expose for so long as 1/10,000 sec., conferred by optical compensation of film movement, greatly simplifies illumination problems which, however, remain formidable enough. Illumination of the subject to a level approximating to sunlight on a fine summer day is necessary.

The camera is comparatively light and compact. It takes a 100-ft. roll of film of the type normally used for amateur cinematography. The base of the camera has been fitted with a timing device. This consists of an electrically controlled 1,000-cycle tuning fork, a small lamp and an optical system which throws an image of the lamp filament on to the edge of the film. The light beam is interrupted by shutter blades attached to the prongs of the fork to give a series of dots along the edge of the film at 1/1,000 sec. intervals.

In the ideal case the photography is simple. However, each problem usually presents special difficulties which must be overcome. A typical example is afforded by an investigation which was carried out of the performance of a drop forging hammer. The hammer weighed 8 tons and the whole machine was based on some 500 tons of concrete. The users were concerned by the slight displacements which took place in this massive base. It was desired to know the extent of movement of the anvil under impact. Observers had put the figure at between ¼ in. and 2 in., and we were asked to carry out measurements

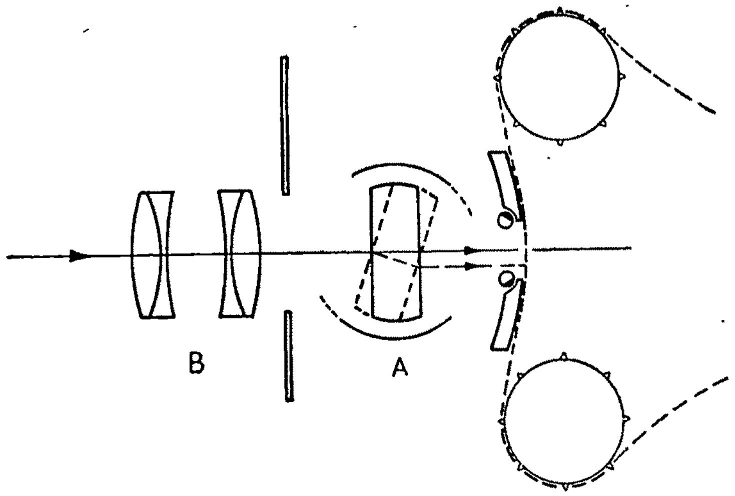

Fig. 3. SCHEMATIC DIAGRAM OF A NON-INTERMITTENT CINE-CAMERA WITH OPTICAL COMPENSATION.

by high-speed photography. The problem would have been simple but for two facts. First, on impact there was a cloud of smoke and flame from the fluxes used in the mould, and the anvil was largely obliterated. Secondly, everything in the vicinity rocked as if by an earthquake, and there was no possibility of insulating the camera from the violent vibrations. Thus it was necessary to include in each photograph some fixed object to which the displacement of the anvil could be referred. This was found in a low-frequency pendulum suspended at the centre of a stretched elastic cord. Vanes attached to the bob of the pendulum dipped in an oil bath and prevented any other than vertical motion. The low frequency of the pendulum—of the order of 2 sec.—prevented it from moving until long after the impact. Thus movements of the anvil only were recorded. A vane on top of the pendulum partly obliterated the image of a bright light source reflected into the camera from a prism which was fixed in the anvil. When the anvil moved, the slit image of the light source widened and narrowed, and these movements were photographed. An analysis of the photographs showed that the movement ended in 1/200 sec. and the maximum displacement was 1/20 in.—five times less than the lowest visual estimate.

Sometimes it is the analysis of the records, and not the photography, which presents unusual difficulties. An ingenious method to overcome them is due to the L.M.S. Railway Research Laboratory. In an investigation of the influence of the profile of the carriage wheel on the smoothness of running of a train, it was desired to measure the sideways motion of the wheel on the rail during travel. Arrangements were made to take a cine-picture of the point of contact of rail and wheel. On each of the many thousands of photographs obtained, the displacement had to be measured—an almost impossible task by ordinary means. The special apparatus which was devised allowed the measurements to be made easily and quickly. In place of the usual cine-projection screen, a 'recording screen' was used, and during projection of the film the recording paper was moved synchronously with the passage of the film through the projector. One observer by means of a lever was able to move the whole screen bodily sideways to keep the image of the rail against a datum line. Another observer kept an index on the image of the wheel and made a trace on the paper. The distance of this from the datum line gave the required information—a kind of 'indicator diagram' on the recording screen which could be evaluated mathematically.

These two examples of the way in which physical devices are used to overcome experimental difficulties must suffice. I am very conscious of many omissions. I have not mentioned Sir Charles Boys' ingenious lightning camera which, in the hands of Schonland and others, has been so fruitful in the analysis of the lightning discharge. I have not mentioned the large amount of work on flame propagation which has resulted in the unravelling of many of the mysteries of combustion[1] by Ellis, Bone and Frazer, to mention three outstanding workers in Great Britain.

My excuse must be that the possibilities of wedding experimental ingenuity to photography are almost boundless. Another omission is the analysis of very slow phenomena. Perhaps here I may plead that there is no problem. There is no difficulty in taking photographs with intervals of minutes or days. The film is projected at normal speed and the passage of time is telescoped. In this way much light has been shed upon such phenomena as cloud formation, the growth of plants, the opening of blossoms, etc.

AREA AND NUMBER OF SPECIES

By DR. C. B. WILLIAMS
Rothamsted Experimental Station

FOR many years there have been discussions of the relation between the size of a sample of an animal or plant community and the number of species contained in it. Until recently, however, most of the approach has been from the botanical side.

So long ago as 1859 Watson[1] gave a table of the area and number of species of flowering plants in each of the 18 provinces and 38 sub-provinces into which he divided Great Britain, and commented on the fact that one square mile of diversified country in the north of Surrey contained nearly half the species of plants of the whole 760 square miles of the county. Much later, Willis[2] touched on the same problem from a slightly different angle, as he was more interested in the frequency of species with different distributions than with the actual number of species in one area. The question was then taken up by Arrhenius, Gleason and others by the use of the quadrat system of examining very carefully all the plants on a number of quite small areas as a random sample of the whole.

Arrhenius[3] considered that the relation between area (A) and number of species of plants (S) on various sizes of plots in the same botanical association was given by the formula A varies as $(S)^n$ where n is a constant for the population under consideration. Rich types (that is, associations rich in species) have a low n value and poor types a high value, but the range of n was quite small. This relation should give a straight line when the log of the area is plotted against the log of the number of species. On the whole the fit of Arrhenius's calculated figures to the observed numbers was not good, and in some examples, especially for rather large areas, very poor indeed.

Gleason[4] studied data from a number of plots of different sizes in an aspen association in Michigan. He came to the conclusion that a straight-line relationship was obtained when the log area was plotted against the actual number of species, and not its logarithm: otherwise that A varies as n^S. This gave a distinctly better fit than Arrhenius's figures for larger areas, but when extrapolated towards the smaller areas gives the curious result that certain small areas must have no species—or even less than none!

Both these theories were developed empirically to find a graph to fit certain observed results, and they were not based on mathematical reasoning.

In all the work on plants, the areas have been the basis of comparison between two or more samples. Plants are sedentary, so that it is easy to decide which plants belong to any particular area; and within one ecological association the number of individuals is probably proportional to the area. On the other hand, it is difficult in many species of plants to decide where an 'individual' begins and ends. In animals the reverse is the case; it is nearly always possible to recognize the individual; but, owing to their mobility, it is difficult to say which animals belonged to which area, particularly if this is small.

The problem of the relation between the number of individuals and the number of species in a random sample of a mixed animal population has been recently taken up. R. A. Fisher has developed a mathematical theory of sampling, based on certain assumptions as to the frequency distribution of different species in the population sampled; and I have shown that these conclusions are very closely supported by results obtained in the field by random samples of insects in a light-trap[5].

Fisher's work suggests that the relation between the number of species (S) and the number of individuals (N) in random samples of a mixed population is given by

$$S = \alpha \log_e \left(1 + \frac{N}{\alpha}\right).$$

The value α is a constant for the population and we have called it the Index of Diversity. It is large for populations rich in species and small for those with few species, and it has a very considerable range of values in observed samples.

If for any one sample from a mixed population we know the number of individuals and the number of species, then α can be calculated, and hence we can find how many species would be represented in any other sized sample from that population. Fig. 1 shows the observed numbers of species of Lepidoptera in samples of eight different sizes taken by means of a light-trap at Harpenden during the years 1933–36. The same diagram shows the calculated relations for various values of α, and it will be seen how closely the observed figures are to the calculated values for $\alpha = 40$. Even the slight departure from this theoretical curve can be explained by the fact that sampling covered several years.

It will be noted that, in Fisher's formula, if the size of the sample N is large compared with α, then the 1 can be neglected in relation to $\frac{N}{\alpha}$ and S is proportional to $\log_e N - \log_e \alpha$. Otherwise (since $\log_e \alpha$ is a constant for the population) for large samples there is a straight-line relation between the number of species and the log size of the sample, just as suggested empirically by Gleason for plants. For smaller-sized samples, Fisher's formula departs from the straight line and is a much closer fit to the observed facts (see Fig. 1). Some botanical applications of this theory are discussed in a paper at present in the press[6].

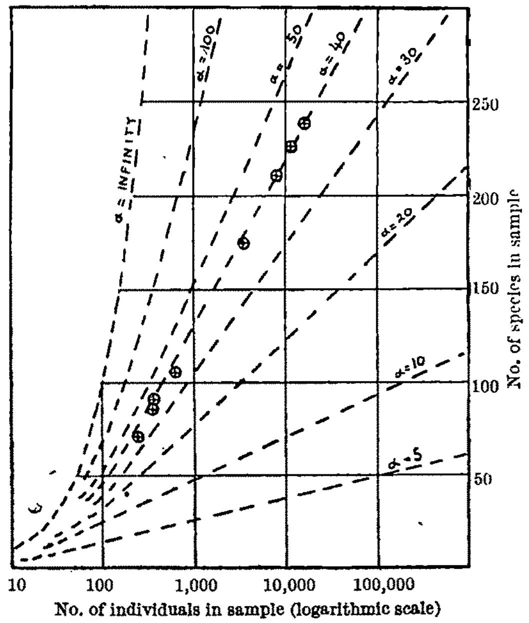

Fig. 1. THE RELATION BETWEEN THE NUMBER OF INDIVIDUALS AND THE NUMBER OF SPECIES IN SAMPLES OF DIFFERENT SIZES, ACCORDING TO FISHER'S LOGARITHMIC SERIES, FOR DIFFERENT VALUES OF THE INDEX OF DIVERSITY 'α'. ALSO THE OBSERVED VALUES FOR 8 SAMPLES OF DIFFERENT SIZES FOR LEPIDOPTERA CAPTURED IN A LIGHT TRAP AT ROTHAMSTED.

This formula gives an apparently sound basis for calculating the relation between the number of species and the size of the sample (either as numbers of individuals or as area) provided that the samples are taken from the same population in the same ecological association. If, in the course of increasing the size of the sample, we extend into a different population or ecological area the number of species will increase more rapidly.

It occurred to me that it would be interesting to see what changes in the number of species were in fact found when the size of the sample was increased far beyond the limits of single ecologically uniform populations. As the number of species concerned is likely to be very large, it was necessary to use for the purpose a diagram showing both species and size of samples on a logarithmic scale, although this does not give a straight-line relationship for sampling from the same population. As plant data appeared to lend themselves better for this study, and to be available in greater quantity, it was decided to plot the number of species of flowering plants against the area sampled over the greatest possible range of areas, from very small to very large.

The results of this investigation are shown in Fig. 2. The heavy central vertical line of the diagram represents one square kilometre of land: to the left

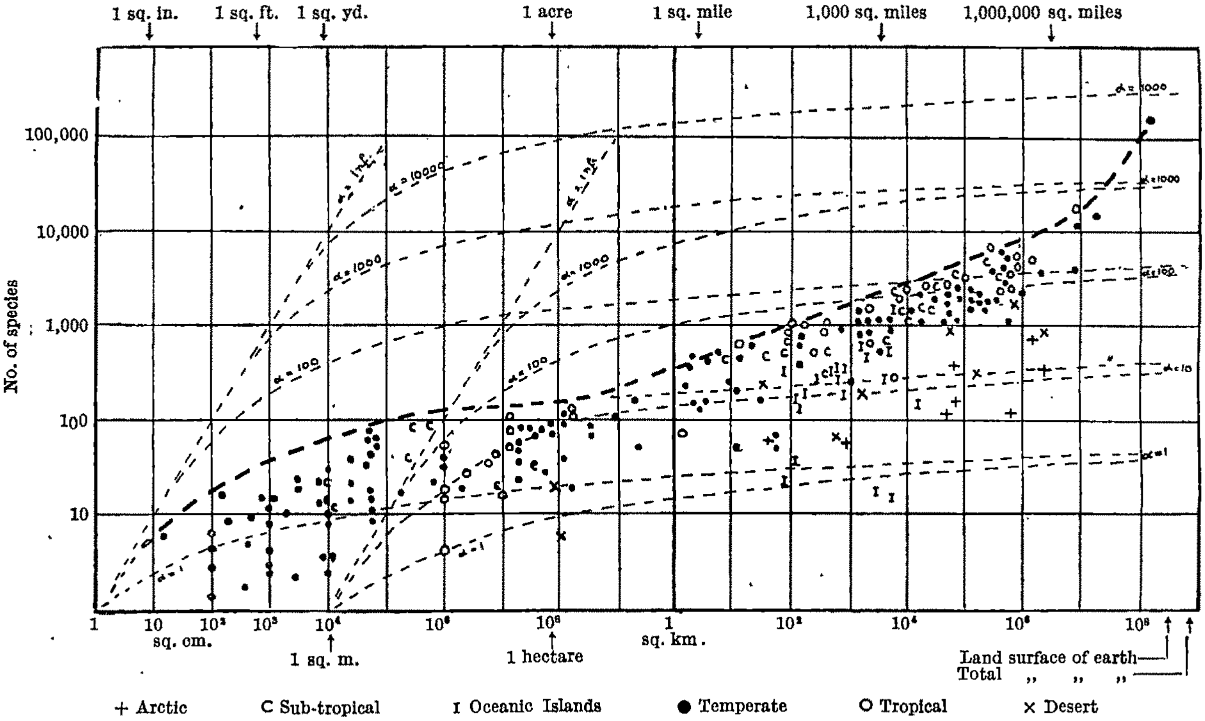

Fig. 2. DIAGRAM SHOWING THE RELATION BETWEEN THE AREA OF A LOCALITY AND THE RECORDED NUMBER OF SPECIES OF FLOWERING PLANTS FOR THAT AREA.

from this the vertical lines represent 1/10, 1/100, etc., of a square kilometre until we reach 1 square centimetre on the extreme left. Moving to the right, we have vertical lines representing 10, 100, 1,000, etc., square kilometres until the one at the right overpasses the total area of the earth's surface. The horizontal lines represent 1, 10, 100, etc., species found in the areas under discussion.

Each point on the diagram represents an actual area of land from which the number of species of flowering plants has been recorded. It was not possible to reproduce here a diagram sufficiently large for each point to be identified to its exact location, so instead they have been distinguished into the chief climatic regions with separate indications of oceanic islands and deserts. The points are not quite evenly distributed throughout the range of the diagram: there is a particular lack of records of areas between two acres and a square mile; and I have only been able to find estimates of the total flora for two continents, North America and Europe. There is a lack of records for small areas both from the tropics and in the arctic and subarctic climates. Many records could not be used because the exact limits of the area were not well defined. In general there is probably a tendency to underestimate the number of species; but, except in a few areas that have been very little studied, the number likely to be added will make very little difference to the position of the record on the logarithmic scale. An increase of 10 per cent in the number of species will only move the point upward through approximately its own diameter.

Superimposed on the diagram by dotted lines are the lines of increase of number of species with size of sample expected by Fisher's theory of randomized sampling in a uniform population (*loc. cit.*). This theory depends on the number of individuals in the sample, and while in general the number of individual plants is proportional to the area sampled, this is not true when we compare grassland with woodland, or woodland with desert or arctic conditions. Available information indicates that there is about 1 plant per square cm. in temperate grassland, about 1 per square metre in woodland, and 1 per 100 square metres upwards in semi-desert areas. The relations on Fisher's series are shown for several different values of the Index of Diversity 'α', and starting from the base line of 1 plant per sq. cm. and 1 per square metre. It will be seen that the lines for the same α values from these two bases gradually approach as the area increases, and for very large areas the number of species to be expected is not very different whether the plant population is dense or sparse. In the extreme case with α = 1 there would only be about thirty-four species in the whole world with 1 plant per square metre, and about forty-two with 1 plant per sq. cm. if the whole world were a uniform eclogical association.

Returning to the distribution of the points on the diagram, it will be seen that they are chiefly scattered over a narrow belt across the figure, the upper limit of which can be divided roughly into three parts. First a period of rapid rise steadily falling away, from the smallest areas of a few square inches to about one or two acres, or one hectare. Secondly, a range of steady rise, almost linear, lasting from about one hectare to large continental areas of about five million square miles. Finally, a very rapid rise from the continental areas to that of the whole land surface of the globe.

It seems to me that these three portions of the limiting curve can be explained as follows. The first part, as will be seen from the diagram, very closely follows the curve for α = 10 of Fisher's theory with about 1 plant per sq. cm.. Otherwise this portion follows the expected increase in species due to increase of size of sample within a uniform population, or within a single ecological association. In other words, up to areas of the order of one or two acres, neither the climate nor the rest of the environment changes very rapidly on an average. As soon as we pass beyond this limit we begin to include new ecological conditions in our sample, with the result that the number of species will increase more rapidly than would be expected if the population sampled remained uniform. This is the second portion of the curve, and the increase of species continues steadily as we increase the size of samples, gradually including more and more variety of ecological formation due either to climate, soil, slope or other differentiating cause. This process continues until we reach the approximate limits of the continents. The slope of this linear portion of the boundary is such that an increase of 1 in the log number of species corresponds to an increase of about 5 in the log area. Otherwise it appears, empirically, that over this range the optimum number of species increases approximately as the fifth power of the area; to double the number of species the area must be increased by thirty-two times.

When we add continents together to get the flora of the whole world, an entirely new factor comes in, that of the evolutionary origin of the floras. Fewer species are common to two continents than to two halves of the same continent. The floras have evolved differently. Therefore, on adding two continental areas together we get a sudden increase on the number of species, far beyond that due to the increase of ecological variety within the area. This is the last steep portion of the curve.

Thus the inverted S-shaped form of the boundary of the belt of points appears to be consistent with the known facts of sampling technique, ecology and evolution.

The position of the points within the belt can be used for pointing out resemblances and differences which may be of great interest. It will be seen, as might be expected, that the tropical and subtropical areas have in general rather more species on the same areas, but the temperate areas run them very closely. On the other hand, the lower portion of the belt is largely made up of floras of either arctic areas, deserts or oceanic islands. The two isolated 'I's' between 10^3 and 10^4 square kilometres are Kerguelen Island and South Georgia, both oceanic islands with, in addition, a sub-arctic climate. If a much larger number of points could be obtained it would be of interest to tabulate each type of climate separately—and possibly to distinguish some of the different associations, such as forest and steppe, which cover large areas.

It is possible from this type of diagram to make rapid comparisons between areas of similar size with different numbers of species, and between areas with the same number of species but different sizes; and new areas can be placed on the diagram and rapidly assessed in relation to those already known.

This enables one to take in a comprehensive view of a range of phenomena which has been insufficiently studied; and also makes it possible to make rapid comparison between the richness of flora of different areas, at the same time allowing for the differences in size. Up to the present it has been easy to compare floras of similar areas but very difficult if they were dissimilar.

I should be glad of any data of area and number of species for other localities so that the diagram can be made more complete and later republished on a much larger scale.

[1] *Cybele Britannica*, 4, 379 (1859).

[2] "Age and Area" (1922).

[3] *Ecology*, 4, 68, 90 (1923).

[4] *Ecology*, 6, 66 (1925).

[5] Fisher, Corbet and Williams, *J. Animal Ecol.*, 12, 42 (1943).

[6] Williams, C. B., *J. Ecol.*, 31 (1943), in the press.

CHROMOSOMIN, A PROTEIN CONSTITUENT OF CHROMOSOMES

By Dr. E. STEDMAN, F.R.S., and Mrs. ELLEN STEDMAN

University of Edinburgh

According to current views, the nuclei of the cells of animals and plants consist, apart from water and lipoids, essentially of two substances: a basic protein (protamine or histone) and nucleic acid. These two constituents are supposed to form a salt-like compound, known as a nucleoprotein (protamine or histone nucleate), which constitutes the so-called chromatin of the nucleus. The results upon which these views are based have been largely derived from chemical studies of the heads of fish spermatozoa. Thus Miescher[1], the pioneer worker on this subject, calculated that the dried heads of salmon spermatozoa contained as much as 96 per cent of salmine (protamine) nucleate, while H. Steudel and Peiser[2] claimed to have reconstituted the nucleoprotein of herring sperm (that is, the dried heads) by the simple expedient of mixing solutions of equivalent quantities of clupein sulphate and deoxyribose-nucleic acid, the protamine having been prepared from herring sperm itself and the nucleic acid from the thymus gland. Other data of a confirmatory nature have been published by various authors, and the results so obtained from the investigation of fish sperm have been generalized and applied to all nuclei, largely on the basis of their histological similarity.

According to a recent review of the subject in NATURE[3] which should be consulted for further references to the literature, this conception of the composition of the nucleus still holds for ripe sperm and for nuclei with chromosomes in metaphase, although in the resting nucleus the euchromatin is believed, on the basis of the ultra-violet absorption spectra determined with the quartz microscope by Caspersson, to contain a small amount of a protein of the globulin type. Some doubt has, however, been raised[4] as to the possibility of distinguishing proteins in nuclei by this method.

These opinions regarding the chemical composition of the nucleus are, however, incorrect.

In the course of investigations which have extended over several years, we have succeeded in isolating from nuclei, in particular from fish sperm, not only a histone (or protamine) and deoxyribosenucleic acid, but also a protein of a new type which we have no hesitation in saying represents quantitatively the major constituent of the nucleus. As will be shown below this protein constitutes the chromatin of the nucleus and hence forms the principal component of the chromosomes. On this account we suggest for it the name of chromosomin. According to geneticists, the chromosomes are the transmitters of hereditary characters. If this is the case, it is evident that chromosomin must play a major part in such transmissions.

Chromosomin is present in all the animal nuclei which we have so far examined. We have not yet determined whether its composition varies with the species from which it is isolated; such variation is, however, to be expected. Nevertheless a protein with the same general properties has been isolated from both cod and herring sperm, from the nuclear material obtained from ox spleen and from the nuclei present in the Walker rat carcinoma.

The most detailed examination of it which we have so far been able to carry out has been made with the chromosomin from cod sperm, and the following data refer in particular to this substance. As isolated from the nuclei it possesses predominantly acidic properties. It is soluble in alkalis and can be precipitated from the solutions so formed by the addition of acids. When free from salts it is dissolved to some extent by dilute acetic acid, but the solution tends to set to a gel. Owing to its insolubility in acetate buffers (about pH 3·0–5·0) we have not yet been able to ascertain its exact iso-electric point, but this evidently lies somewhere between these pH values. About 25 per cent of the molecule is composed of basic amino-acids, there being present arginine (9·5 per cent), histidine (5 per cent) and lysine (11 per cent). The value for arginine is, we believe, quite accurate; those for histidine and lysine may require slight adjustment in the future, but such adjustment, if necessary, will only involve a change in the relative amounts of the two amino-acids. The acidic properties which chromosomin possesses, despite its high content of basic amino-acids, are almost certainly due to the presence in the molecule of relatively large amounts of glutamic acid, which substance we have isolated in a pure crystalline state from its hydrolysis product. Aspartic acid has similarly been isolated, although in smaller amount. Chromosomin is also characterized by its relatively large content of tryptophane. Other mono-amino-acids, including cystine (0·4 per cent), are also present, but their identity has not yet been ascertained. A small amount of labile sulphur is lost from the nuclear material during the isolation of chromosomin; the origin of this is, however, undetermined.

That chromosomin represents the principal component of the chromosomes is readily shown by staining experiments. For this purpose we have used a preparation dried by successive treatment with alcohol and ether and so rendered completely insoluble in water. When such material, which corresponds to the fixed tissue of the histologist, is placed in a solution of a basic dye (for example, methylene blue, gentian violet) it takes up the latter by virtue of its acidic properties, and on repeatedly washing the centrifuged material with water, the dye is slowly removed. In this respect the behaviour of chromosomin parallels that of the chromatin in the nucleus. Other acidic proteins would, no doubt, behave similarly; chromosomin is, however, the only protein of this type present in any considerable amount in the nucleus.

But perhaps the most convincing evidence of the identity of chromosomin and chromatin is its characteristic behaviour towards hæmotoxylin. When stained with this dye it assumes the typical blue colour familiar to histologists. The stain is, moreover, very firmly held despite repeated washings with water. Casein, an acidic protein not found in the nucleus, is also stained by hæmotoxylin, but in this case the material assumes a purple colour which is quite distinct from the characteristic blue produced with chromosomin. There can, we think, thus be no doubt that the staining properties of chromosomes are due to the chromosomin in these nuclear organs.

It is, we believe, generally assumed that nucleic acid, the only acidic component of the nucleus hitherto known, is mainly, if not entirely, responsible for its behaviour towards basic dyes, and on this postulate the hypothesis has been developed that the chromosomes are largely composed of this acid. This hypothesis receives apparent confirmation from the results obtained with Feulgen's stain. It is, in fact, now generally believed that Feulgen's reagent which, according to its discoverer, reacts specifically with the hydrolysis product of deoxyribosenucleic acid, is capable not only of detecting nucleic acid in the nucleus but also of locating its actual position. While there is little doubt that Feulgen's reagent is of great service in detecting deoxyribosenucleic acid, the idea that it can locate the position of this material in the nucleus is based on a misconception of the processes involved. The stain, whatever its exact nature may be, liberated from the reduced magenta by the hydrolysed nucleic acid, is freely soluble in water. Hence, once it has been formed in the nucleus, it is capable of behaving exactly as do other basic dyes. Apart from the necessity of hydrolysing the nucleic acid before the application of the stain, Feulgen's technique differs from ordinary staining technique merely in the fact that the stain is developed inside the nucleus in limited amount and is not applied from outside. That this explanation is correct can be readily demonstrated. If some hydrolysed deoxyribosenucleic acid is treated with Feulgen's reagent and the mixture allowed to stand until the colour is fully developed, a clear solution with a purple colour is obtained. If some chromosomin is now introduced into this solution, it takes up the dye in exactly the same way as do the chromosomes, assuming a purple colour with a much bluer tinge than that of magenta itself.

The staining properties of the chromosomes towards both basic dyes and Feulgen's reagent are thus due to their content of chromosomin, and the evidence indicating the presence in them of nucleic acid is shown to be fallacious. Nevertheless, we do not wish to claim that the chromosomes are composed entirely of chromosomin. Other undetected substances may be present in small amount, and the facts we have adduced do not exclude the presence of some nucleic acid. A consideration of some quantitative data, however, points to the conclusion that at least part of the nucleic acid is exterior to the chromosomes. Thus, of the three main components of dried nuclei, namely, chromosomin, nucleic acid, and histone, the last two can be estimated with a fair degree of accuracy, the histone by direct isolation and the nucleic acid by a determination of the phosphorus content. Making the assumption, which we believe to be substantially correct, that the remainder of the material consists of chromosomin, we arrive at the composition of the nuclei.

The following results were obtained in this way:

Nuclei	Nucleic acid	Histone	Chromosomin
Cod sperm	28%	12%	60%
Ox spleen	34%	16%	50%
Walker rat carcinoma	26%	1·6%	72·6%

It should be emphasized, however, that the composition of the nuclei is not constant. Some specimens of cod sperm which we have examined have, for example, contained as much as 23 per cent of histone, while the nuclei from the rat carcinoma have sometimes failed to yield any histone at all. The figures do, however, indicate that chromosomin forms the largest constituent of the nucleus, and since it represents the characteristic substance of the chromosomes, there would appear to be little material left to form the nuclear sap unless this contained some nucleic acid. It is an attractive hypothesis, but one for which there is no direct experimental proof, that the spindle which is formed at metaphase is a gel of nucleic acid. The attachment of the chromosomes to the equatorial plate of the spindle could then be conceived as involving perhaps the acidic groups of the nucleic acid and basic groups of the chromosomin, the acidic groups of the latter being neutralized by the histone. Alternative methods of combination are, of course, possible. But the important experimental fact is that the nucleus is composed of at least three amphoteric substances: chromosomin, nucleic acid and histone (or, in special cases, protamine), two of these possessing predominantly acidic properties and one, the histone, predominantly basic properties. Between three such substances a number of salt-like unions could be formed, the nature of which would be controlled by the acidity of the medium in which they existed. It is not, however, our present purpose to speculate on the nature of the changes which occur in the nucleus; discussion of this and other aspects of our work will be reserved until it is possible to give a more detailed account of our experiments.

We desire to thank Dr. A. Haddow of the Chester Beatty Cancer Research Institute for providing us with the Walker carcinoma tissue, and the Medical Research Council for a grant to one of us.

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[2] Steudel, H., and Peiser, E., *Z. physiol. Chem.*, **122**, 298 (1922).

[3] Darlington, C. D., NATURE, **149**, 66 (1942).

[4] Mirsky, A. E., "Advances in Enzymology", **3**, 1 (1943).

OBITUARIES

Sir Stopford Lauder Brunton, Bt.

SIR STOPFORD BRUNTON, who died on July 25, was the elder son of the late Sir Thomas Lauder Brunton, the eminent physician. He was born on October 11, 1884. He was educated at Cheltenham College, from which he went to the Royal Military Academy, Woolwich, and later to McGill University, Montreal. There, after studying mining geology, he took his degree in 1912. He worked on the Canadian Geological Survey until the War broke out in 1914. Holding a commission in the O.T.C., he drew up a scheme of military training which was accepted at Ottawa, and led to his being sent to France to study modern methods of field-defence. On his return to Canada he raised No. 6 (McGill) Heavy Siege Battery, recruited from graduates and undergraduates of the University, and as officer commanding, took his unit to France in 1917, remaining on that front until the end of the War.

For the next six years Sir Stopford was engaged on survey and mining in Nova Scotia. The results of his work were embodied in two publications, the second of which, "The Gold Deposits of Nova Scotia: a New Hypothesis concerning the Structural Features of the Province", published in 1925, was awarded the Leonard Gold Medal for 1927, jointly by the Engineering Institute of Canada and the Canadian Institute of Mining and Metallurgy. Sir Stopford, in spite of failing health in recent years, was keenly interested in agricultural progress in Nova Scotia, where he owned a farm.

Inheriting the high ideals of his father and something of the fine quality of his genius, he had much personal charm and a kindly, unselfish, generous nature, to which the affectionate devotion of his friends and former comrades offers a fitting tribute. Sir Stopford married in 1915 Elizabeth, daughter of Prof. J. Bonsall Porter of Montreal, and leaves a son and a daughter. The former is now serving in the Royal Canadian Army Medical Corps.

Dr. A. C. Klebs

DR. ARNOLD KLEBS, the eminent Swiss medical historian, died on March 6 at Nyon, on the Lake of Geneva. Born on March 17, 1870, the son of Prof. Edwin Klebs, the famous bacteriologist who was successively professor of pathology at Bern, Würzburg, Prague, Zurich and Chicago, he received his medical training at Bern, Kiel, Würzburg and Berlin, and qualified at Basle in 1894. After post-graduate work in London and Paris, he went to the United States at the age of twenty-six. He gained a reputation by his work on tuberculosis, for which he founded a sanatorium in Alabama and a tuberculosis institute in Chicago. Afterwards he made the acquaintance of the late Sir William Osler, who inspired him with an interest in the history of medicine.

One of Klebs' earliest articles on this subject was the history of inoculation against smallpox (1913). Eventually he published a large number of medico-historical essays either independently or in collaboration with Sudhoff, to whom he devoted a remarkable article on Gianmatteo's "Practica" in the *Festschrift* in honour of Sudhoff's seventieth birthday.

In 1921 Klebs played an active part in the foundation of the Swiss Society of the History of Swiss Medicine and Sciences, which holds a congress regularly every year. In 1938 he published a standard work, "A Short Title List of the *Incunabala scientifica medica*". His last great work was a bibliography of the writings of his friend Harvey Cushing, which appeared on the occasion of the seventieth birthday of the great brain surgeon. His own seventieth birthday was celebrated by Prof. Henry Sigerist, of Baltimore, in a *Festschrift* which appeared in the *Bulletin of the History of Medicine* in 1940. His last years were embittered by the War, which deprived him of the visits of his friends in Europe.

J. D. ROLLESTON.

WE regret to announce the following deaths:

Prof. F. Bacon, professor of engineering in University College, Swansea, on August 23, aged sixty-two.

Prof. W. G. de Burgh, F.B.A., emeritus professor of philosophy in the University of Reading, on August 27, aged seventy-six.

Prof. John Hilton, professor of industrial relations in the University of Cambridge, on August 28, aged sixty-two.

NEWS AND VIEWS

The British Council

The report of the British Council for the year ending March 31, 1943 (London: British Council, pp. 108), indicates a steady expansion of the work of the Council making known the life and thought of Britain abroad. The detailed description of the exchange between this and other countries of information on the work of men of science, doctors, engineers, teachers, lawyers, trade unionists, scholars, musicians and artists given in the report indicates the way in which the Council is helping to bring about a real place of understanding by the people of the peoples of the world and the increasingly important place of the Council's work in the United Kingdom in relation to the future of Europe. The Council is responsible for the educational and cultural welfare of the Armed Forces of our European Allies stationed here, for that of Allied neutral merchant seamen reaching our ports, and for that of foreign civilians, and the facilities for instruction and recreation made available have proved no less welcome to the Armed Forces of the Dominions, in particular the Canadian Army and Royal Canadian Air Force and soldiers, seamen, technicians and others from the British Colonies and India. The Conference of Allied Ministers of Education which was initiated at the suggestion of the Council has appointed two Commissions—one to consider the negotiation of bilateral treaties of understanding or cultural conventions and the other to report and make recommendations on questions affecting the supply of books and periodicals to the occupied countries of Europe after the War, including the restocking of national and university libraries destroyed or damaged by the Germans, the provision of text-books for university students and for schools, and a brief factual history of the War. In Turkey a number of university appointments were made by the Turkish authorities on the Council's recommendation, including that of Dr. F. A. Constable to the chair of physical chemistry at the University of Istanbul. An exhibition of photographs of British scientific achievements was opened at Istanbul, and in the Soviet Union the recently established scientific bureau of the U.S.S.R. Society for Cultural Relations has appointed the head of the Council's Science Department as its agent for the supply of information about science and scientific workers in Britain. A number of articles have been written especially for the Scientific Bureau by Sir Stafford Cripps, Dr. Julian Huxley, Dr. C. D. Darlington and Mr. J. G. Crowther.

With regard to science, in addition to continuing the issue of *Monthly Science News*, a series of broadcast talks have been arranged or advised for the B.B.C. Overseas Service and a number of volumes published in the "Science in Britain" series. Arrangements were made for the medical abstracts prepared by the British Medical Information Service to be printed under the title of *British Medical Bulletin*, and these abstracts are sent to the editors of overseas medical journals in English, Spanish and Portuguese. A number of original articles, commissioned from British medical experts, have been published or accepted for publication in medical journals of good standing. Considerable attention has been given to medical films. The Medical Department of the Council is answering an increasing volume of general medical inquiries from other countries. The Engineering Panel has advised on questions affecting technical education in Turkey and articles on engineering science have been forwarded to Turkey, Egypt, the British West Indies and elsewhere. Many foreign universities and educational authorities rely on the Council to recommend British scholars or research workers to fill University appointments abroad, and the Council has also participated in the training of Allied personnel for reconstruction, a number of scholarships having been awarded in collaboration with the Allied Governments for post-graduate and undergraduate study, and a further course has been arranged in London for Allied civil servants, with lectures on British administration and classes on British diplomatic and legal terminology.

The Council has continued its policy of presenting books to increase the libraries of British institutes and anglophile societies, in universities, schools, libraries and other institutions abroad, and in the United Kingdom to British subjects from the Empire and foreign lands, a very substantial proportion of the books sent abroad being of a scientific, technical and specialized kind. The Council has continued to take a direct interest in the export trade of books both by encouraging the sale of British books of cultural value in foreign bookshops, conducting its exhibition of books which have a commercial as well as a prestige value, facilitating the review of British books in the foreign press and arranging for the publication of more British books in the original or in translation.

Review of the Aircraft Industry

The tenth report of the 1942–3 session of the Select Committee on National Expenditure pays brief tribute to the remarkable industrial achievement of the aircraft industry. The production of aircraft is now substantially balanced, and, with the exception of spares, there is at present no single field of production where a serious bottleneck threatens to retard output. Most of the Committee's recommendations are minor, but taken together they suggest that there is still room for considerable all-round improvement in the efficiency of the industry. Better personnel management, for example, should assist in reducing an excessive turnover of labour. Again, the industry is suffering from an acute shortage of scientific and technical men and there are not enough adequately qualified men to maintain the industry at the proper level of efficiency, this applying also in the whole field of aeronautical research. Special measures are necessary and men of high academic, scientific or technical attainments should not, in the Committee's view, be allowed to be absorbed in the fighting services, where, even when they are employed in technical jobs, their qualifications are often much higher than is needed. Facilities should be provided for training scientific and technical personnel as well as for training managerial staff of all grades, including foremen, and more use made of the Ministry of Labour's courses in foremanship.

In regard to the dissemination of scientific and technical information the Committee considers that bearing in mind the limitations upon publication which the need for secrecy imposes, the arrangements on the strictly scientific side are adequate. Firms who are in difficulties with regard to technical problems can get the fullest possible help from other firms, but for reasons of prestige are sometimes reluctant to apply for help. In the less technical problems firms are not always ready to profit by the experience of others, and the report comments on the aircraft industry's neglect of statistical methods of quality control. Other recommendations for improving efficiency include the strengthening of design staffs by the appointment of draughtsmen with actual experience of production engineering, and arranging that design and development offices and planning departments are within the same premises and housed as close to each other as possible. More appointments similar to that of the technical advisor to the chief executive should be made, even if it involves the temporary withdrawal of men occupying important positions in the industry. In regard to the co-ordination of production with research and development the report notes that the importance of this requirement has lately received greater recognition, and strenuous efforts are made to this end through weekly meetings of the controller of research and development with the officers responsible for production. The advantages of collective consultations on the allocation of orders in important changes of programmes are stressed and also the necessity for close attention to the problem of reducing the loss of output caused by change-over from an old to a new type.

Dr. Carl Voegtlin

DR. CARL VOEGTLIN has resigned from the directorship of the National Cancer Institute, U.S. Public Health Service. Dr. Voegtlin, who has been director of the Institute since its foundation in 1938, is sixty-four years of age. He has recently been presented with a portrait of himself at a meeting of the U.S. National Cancer Advisory Council. Before taking over as director of the National Cancer Institute, Dr. Voegtlin had been chief of the Division of Pharmacology in the National Institute of Health. He went to that Division of the U.S. Public Health Service in 1913 from Johns Hopkins Medical School, where he had been associate professor of pharmacology. Born in Switzerland and educated in the Universities of Basel, Munich, Geneva and Frieberg, Dr. Voegtlin has had a distinguished career, and an international reputation for his researches in physiology, pharmacology and cancer.

Summer School in Biology and Health

APPROXIMATELY 250 students attended the Summer School in Biology and Health of the Central Council for Health Education held during August 4–14 at the Chelsea Polytechnic, London. They represented a very wide variety of educational activity, including junior, senior and secondary school teachers, head teachers, training college lecturers, health visitors and nurses, educational administrators, teachers of physical education and domestic science, and representatives of commercial houses. This mixture of different categories was particularly valuable in discussion, since it enabled the various points of view to be expressed. These discussions, and particularly those on sex education, were most fruitful. During the School, students visited experimental stations, health centres and clinics, and there were demonstrations of biological experiments, health education pamphlets and teaching material. In addition, there was a display of text-books and shows of biological and health education films.

Among the lecturers at the School were Dr. Charles Hill, who gave the inaugural address on "Biology and Health", Prof. C. W. Valentine and Prof. Lancelot Hogben of Birmingham University, who spoke on "Early Childhood" and "Biology as a Social Science" respectively. Miss Enid Blyton described "Education Through Story Telling", Miss F. Brackenbury gave an address on "Practical Methods in Health Teaching", Prof. J. R. Marrack spoke on "Social Aspects of Nutrition", Mr. L. J. F. Brimble lectured on "Social Studies and World Citizenship", and Sir John Russell gave the final address, on "Agricultural Developments in the U.S.S.R." The demand to attend the School was so great that many prospective students had to be turned away, and it is likely that next year more Schools will be held both in the North and in the South of England.

Sociological Value of Family Meals

FAMILY table talk plays a vital part in rearing children. During mealtime, the time when the whole family is likely to be together, children learn moral values, absorb family culture, and develop as individuals, according to Prof. J. H. S. Bossard, of the University of Pennsylvania (*Amer. Sociol. Rev.*, June 1943). The dining-room is often the real social centre of the household, and the family is apt to be at its greatest ease at the dining table. The influence of conversation at this time is subtle and intangible, but the part which it plays in rearing children is most important.

Mary's place in the family group becomes most clearly defined and the family serves as her sounding-board during meal-time. Both in the responses given and withheld, the family carries great weight in the moulding of her personality. It is here that the individual members aid in enlarging each other's vocabulary, and "facility and quickness in expression constitute the price for admittance to the conversation", states Dr. Bossard. The family dining table is likened to a clearing house for information, news, and experiences. In some families, according to Prof. Bossard, meal-time serves as a forum, sometimes it substitutes for class-room instruction, and again it may be the one place where problems of importance to the entire family are thrashed out. A child's interests can be stimulated and directed during meals. If Mary has artistic, literary, or mechanical interests, family table talk can either increase or dampen the development of these interests.

Almanacs and Health Education

ACCORDING to an editorial in the February issue of the *Boletín de la Oficina Sanitaria Panamericana*, almanacs have recently been revived as a means of health education. The Division of Malariology in the Argentine, for example, lately used this device in its anti-malarial campaign, and in Venezuela the Ministry of Public Health and Social Welfare published health calendars in 1940. The calendar reaches every social level, including peasants, schools, industrial groups and every public and private institution. A national calendar may include among other items notes on scientific advances of general interest, radio progress, museums, periodicals, ways of preparing food, vaccination, rules for maternal and infant hygiene, social security legislation and economic data.

Insect Pests of Stored Products

THE British Museum (Natural History) has recently issued a useful illustrated pamphlet (Economic Series No. 15) entitled "Common Insect Pests of Stored Food Products". Every year many inquiries relating to pests of this kind are received by the Museum. Usually the identification of such pests is not a matter of much difficulty, whereas the giving of advice on control measures is often very far from being easy and straightforward. The provision of this kind of advice is not properly the concern of the Museum staff, and, for this reason, the Trustees have welcomed the recent establishment of a Pest Infestation Laboratory by the Department of Scientific and Industrial Research and of an Infestation Branch under the Ministry of Food. The present booklet has been prepared at the request of these two organizations, and it aims at making easy the identification of the insects and arachnids commonly associated with stored products in Great Britain. The authors, Drs. H. E. Hinton and A. Steven Corbet, have avoided the use of any but the most elementary technical terms, so that the layman—apart from the entomologist—should be able to identify most of the pests that he is likely to come across. The pamphlet is obtainable, price 1*s*., through a bookseller.

Protective Finishes for Scientific Apparatus

THE June issue of the *Journal of Scientific Instruments* consists mainly of three papers which constitute a symposium on "Protective Finishes for Scientific Instruments and Apparatus". In a foreword, Mr. A. J. Philpot, director of research of the British Scientific Instrument Research Association, counters criticism of its value by pointing out the useful purpose served by "Any publication in which there is gathered together in a condensed form the available information on the various technical processes relating to a specific subject". In the present case, stronger emphasis would have been justified. Dr. Sutton's paper, for example, surveys dispassionately, and with the authority of unique experience, the relative merits of various protective treatments for different materials, pointing out the causes of corrosion troubles in instrumental work. It would be difficult, if indeed possible, to find the same information elsewhere in the literature. Dr. Bovey's survey of available anodic oxidation processes for aluminium alloys provides, in small compass, the essential information on their applicability and the characteristics of the films they yield. 'Review', 'summarize' and 'survey' are verbs of particular utility to a reviewer of technical literature. Unfortunately, they do not fit Mr. Wornum's paper on protective paints and varnishes. The most apt description is perhaps 'concise treatise', dealing, as it does, with the underlying principles of the processes involved in applying different types of coating as well as the properties and uses of these. Mr. Philpot may rest assured that there is little need to defend this symposium. It will be welcomed by all who use scientific instruments as well as those who make them.

New Seismograph in Mexico

A NUMBER of prominent American men of science, including Dr. Harlow Shapley, Dr. S. Chandrasekhar, Dr. Percy Bridgman and Dr. L. Don Leet, were present at the dedication of the new seismograph at the National Astrophysical Observatory at Tonanzintla in Mexico by invitation of President Avila Camacho and the Governor of Puebla. The occasion was the first National Conference of Physics at Puebla. The seismograph, which was acquired by the State of Puebla, is a Benioff vertical-component instrument obtained through the National Research Council of Washington and the Harvard Seismological Station, and has been thoroughly tested by the Rev. Daniel Linehan, *S.J.*, of Weston College (*Earthquake Notes*, 14, Nos. 3 and 4; June 1943). The instrument is expected to contribute to a large extent to the study of earthquakes in Mexico and the activities of sleeping volcanoes. The observatory where it has been housed is just east of the mountains Popocatepetl and Ixtaccihuatl. The installation appears to be timely, for a new volcano began eruption in the State of Michoacan, Mexico, on February 20, 1943. This is some two hundred miles west from Mexico City at an elevation of about 6,000 ft., near the town of Paricutin, which has had to be evacuated. Earthquakes are relatively frequent in many parts of Mexico, and a stronger one than normal occurred on February 22, 1943, at a point near the Pacific coast roughly 140 miles from the volcano in a direction 30° east of south. The shock was felt strongly in Mexico City. There is no known connexion between the earthquake and the volcano just mentioned.

Announcements

ON the occasion of President Roosevelt's visit to Ottawa on August 25 the Chancellor of the University of London, the Earl of Athlone, on behalf of the Senate, conferred on him the degree of doctor of laws *honoris causa*. H.R.H. Princess Alice, Countess of Athlone, and the Prime Minister of Canada were present on the occasion; and the oration was read by Captain H. C. Best, professor of physiology in the University of Toronto.

MR. A. W. LING, chief agricultural advisory officer, University of Bristol, has been appointed principal of the Seale-Hayne Agricultural College, Newton Abbot.

PROF. R. A. S. MACALISTER has resigned from the chair of Celtic archæology in University College, Dublin. He is succeeded by Prof. S. F. O'Riordan.

MR. P. G. HYSLOP has ceased to be a member of the Coal Commission of the Minister of Fuel and Power on the expiry of his term of office, and Lieut.-Colonel J. A. S. Ritson has been appointed a part-time member of the Commission to fill the vacancy.

THE British Rheologist's Club is holding a meeting at Loughborough College on September 18 at 10 a.m. The subject for discussion will be "Rheology in the Hosiery, Leather, Shoe and Allied Trades". Further information can be obtained from the Secretary, British Rheologist's Club, c/o Institute of Physics, The University, Reading.

A COURSE of three lectures and discussions on "Engineering Economics" will be given by Sir Frank Gill, director of the International Standard Electric Corporation and chairman of the Standard Telephones and Cables, Ltd., at the Institution of Electrical Engineers on Tuesdays at 5.30 p.m. beginning on September 21. These lectures are arranged by the University of London, and further information can be obtained from the Accountant, University of London, Senate House, Bloomsbury, London, W.C.1.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Riboflavin and Vitamin B_1 in Nineteenth Century Buns and Ale

RECENTLY, one of us (H.S.S.) was presented by Mr. H. W. Hedges, of Fairford, Gloucester, with two currant buns; one was baked in 1863 to celebrate the wedding of the Prince of Wales and the other in 1887 for Queen Victoria's jubilee. Both had been kept as souvenirs of the "Cakes and Ales" custom for celebrating national festivities. Except for a granite-like quality, they were in perfect condition, even to the currants, and on analysis gave the following results:

	1863 bun	1887 bun
Moisture	13·0 per cent	13·6 per cent
Protein	11·4 ,, ,,	11·3 ,, ,,
Fat	5·2 ,, ,,	4·4 ,, ,,
Fibre	0·2 ,, ,,	0·4 ,, ,,
Vitamin B_1	0·15 I.U./gm.	0·35 I.U./gm.
Riboflavin	9·3 μ gm./gm.	7·3 μ gm./gm.
*p*H (1 part bun/2 parts water)	4·4	5·0

Microscopical examination showed that both buns were made with yeast or barm. The most interesting feature of the analyses is the high value for riboflavin; the vitamin was determined microbiologically[1].

Two further buns have been examined (made 1888 and 1890) and gave the following figures (expressed on a 13 per cent moisture basis):

	1888	1890
Fibre	0·4 per cent	0·5 per cent
Vitamin B_1	0·05 I.U./gm.	0·10 I.U./gm..
Riboflavin	5·6 μ gm./gm.	4·7 μ gm./gm.

The average vitamin B_1 and riboflavin contents of the four buns are 0·15 I.U./gm. and 6·7 μ gm./gm., respectively. These figures compare with approximately 1 I.U. and 1·5–2·4 μ gm./gm. for present-day buns. The ancient buns were almost certainly made with brewers' yeast, and it is to this constituent that we must look for the explanation of the high riboflavin content. Incidentally, currants give a value of approximately 1 μ gm./gm.

Examination of a number of dried plain and debittered brewers' yeasts (12–13 per cent moisture) has given the following average results:

Vitamin B_1	33 I.U./gm.	(9·5)
Riboflavin	54 μ gm./gm.	(15)

The figures in brackets are the calculated figures for the corresponding wet yeasts (approximately 75 per cent water content).

The recipe from which the buns were made is unknown, but was possibly something similar to the Hannah Glass 1780 recipe which reads:

"Take two pounds of fine flour, a pint of good ale yeast, and three eggs beaten, knead all these together with a little warm milk, a little nutmeg, and a little salt, and lay it before the fire till it rises very light, then knead in a pound of fresh butter, a pound of rough carraway comfits, and bake them in a quick oven, in what shape you please, on floured paper."

This recipe would indicate a fat content of about 20 per cent in the dried bun, so that it must be assumed that the quantity of butter used in the buns under discussion was not so generous.

In attempting to calculate the vitamin B_1 and riboflavin contents of a "Hannah Glass bun", the difficulty is the yeast content of the "pint of good ale yeast"; despite many inquiries, we have been unable to obtain even an approximate figure. If, however, we calculate backwards, taking the riboflavin contents of flour, eggs, milk and butter as 1·5, 5, 1·5 and 0·1 μ gm./gm. respectively, and assuming ½ lb. of butter and ½ pint of milk in the recipe, it would follow that the pint of ale yeast contained something of the order of 8,000 μ gm./gm. of riboflavin.

As shown above, present-day wet brewers' yeast has a riboflavin value of about 15 μ gm./gm. On the other hand, it was thought that yeast grown on all-malt mashes might have a higher value. Accordingly, a sample was grown in the laboratory and gave on analysis vitamin B_1 and riboflavin figures of 9·3 I.U. and 23 μ gm./gm. (75 per cent water content), or slightly higher in riboflavin than the figure obtained for commercial yeasts. To complete the picture, four samples of present-day beer were examined and gave three values of 0·9 and one value of 1·7 μ gm./c.c. We have since been in touch with Prof. R. H. Hopkins and found that he has also obtained similar results with a wider range of beers and stouts (see p. 274). The explanation for the relatively high riboflavin content of beer has still to be worked out, but assuming there is little autolysis or 'release' of riboflavin from the yeast, it could be explained by assuming complete extraction from the malt if the latter has a value of about 8 μ gm./gm., or more than three times that of raw barley[1]. This is not unreasonable in view of the work of Davis, Laufer and Saletan[2], who found this ratio although their value for raw barley was low, namely, 1·02 μgm./gm. Whatever the explanation, it would appear that beer is not an unimportant source of riboflavin. Further, in the days when it was of much higher gravity, it may be assumed that the riboflavin content was correspondingly higher.

Taking 25 μ gm./gm. and 2 μ gm./c.c. as possible values for yeast and ale, it would follow that for a total amount of 8,000 μgm. each pint of ale yeast contained approximately 300 gm. of wet yeast. Such a quantity is, however, unlikely since it is generally assumed that 5–8 lb. of brewers' yeast for 280 lb. of flour (that is, 25 gm. per 2 lb. of flour) is the limit, at least in bread-making, before a bitter taste appears. We have, therefore, so far been unable to explain satisfactorily the riboflavin values found in these ancient buns. It is, however, due either to the high value for the yeast or beer of those days, or to the larger quantity that could be used. It is also of interest to note that the bread made at that time would probably also have a higher riboflavin content than even present National bread (approximately 1·1 μg./gm.), and this fact will be of importance in any historical survey of riboflavin intake.

The average figure of 0·15 I.U./gm. for the vitamin B_1 content of the buns shows that, unlike the riboflavin, there had been considerable destruction of this vitamin in the 50–80 year interval. It is difficult to fix with any accuracy the extraction of the flour used, but the fibre figure suggests an extraction in the region of 80 per cent.

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T. MORAN.
H. S. SARSON.
Cereals Research Station, St. Albans, and
British Vinegars, Ltd., S.W.1.

Aug. 12.

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[1] Barton-Wright, E. C., and Booth, R. G., *Biochem. J.*, **37**, No. 1, 25 (1943).

[2] Davis, C. F., Laufer, S., and Saletan, L., *Cereal Chem.*, **20**, No. 1, 109 (1943).

Riboflavin and Vitamin B_1 in War-time Beers

FOR some time past determinations of these vitamins in beers and stouts, obtained by ordinary retail purchase, have been in progress in these laboratories. For riboflavin a microbiological method[1], latterly improved[2], has been employed, whereas aneurin was measured by a fermentation technique[3] using an appropriate strain of bakers' yeast. When sufficient aneurin was present (in the strongest beers), the thiochrome fluorimetric procedure, involving a fundamentally different principle[4], was used as a check.

The riboflavin results have been surprisingly high in the fourteen beers so far tested, the lowest being 0·47 and the highest 1·2 micrograms per c.c. Strong ales are likely to contain more, but none has so far been tested for riboflavin.

As regards aneurin, results of sixteen beers have ranged from 1 to 6 I.U. per 100 c.c., and here three 'strong' ales have been included.

From other observations in progress, it can already be stated that, while much aneurin is lost from bright beer and is removed with the yeast, almost all the riboflavin present in the original malt remains in the beer, and this is a useful amount.

R. H. HOPKINS.

British School of Malting and Brewing,
University of Birmingham.
Aug. 12.

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[2] Barton-Wright, E. C., and Booth, R. G., *Biochem. J.*, 37, 25 (1943).

[3] Schultz, A. S., Atkin, L., and Frey, C. N., *Ind. Eng. Chem.* (Anal.ed.), 14, 35 (1942).

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Inactivation of Enzymes by Irradiation

IN consideration of recent communications[1,2] on the chemical action of X-rays on enzymes, and of the renewal of the discussion on the relative role of 'direct hit' and 'indirect action' in enzyme-ray reactions, it seems to us timely to record here certain observations relevant to this question from an investigation in progress on the influence of ultra-violet light on enzymes.

According to Leibowitz *et al.*[3,4,5] the maltose-splitting and the sucrose-splitting activities of taka-diastase must definitely be attributed to two distinct and specifically different agents. Nevertheless, taka-maltase and taka-sucrase show identical inactivation curves when irradiated by ultra-violet light. The inactivation curve of yeast-sucrase, on the other hand, follows a different course. It seems that it is the nature of the accompanying substances (the 'colloid carriers') rather than the enzyme as such that is of decisive importance for the behaviour of the enzyme under irradiation.

It is generally assumed that the susceptibility of enzymes to radiation is increased by dilution. This principle holds in the case of the enzymes named above for dilution with water. It does not hold, however, if the same enzymes are diluted with an inactivated solution of the corresponding enzyme preparation. In other words, when the concentration of the active enzyme molecules is decreased alone, that of the accompanying substances being kept constant, the effect of ultra-violet radiation becomes independent of the concentration of the substrate, that is, the enzyme. Using concentrated solutions of the inactivated material as diluent, dilution actually exerted a protective action on the stability under irradiation of the enzymes. This again tends to confirm the view that accompanying substances are of primary importance in the mechanism of enzyme inactivation by irradiation.

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June 15.

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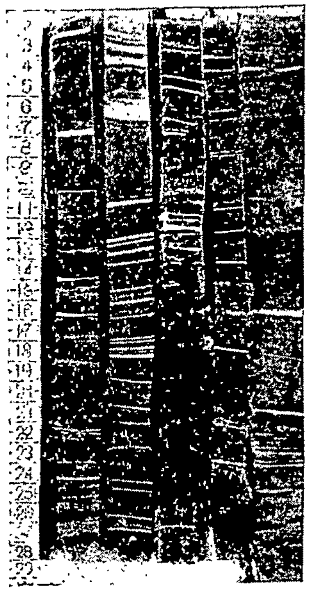
Bacteria in the Bottom Sediments of the Dead Sea

IN order to investigate the presence of different physiological groups of bacteria in the different layers of the bottom sediments of the Dead Sea[1,2,3], it was essential to obtain profiles of mud samples. With a coring instrument designed according to the device of Emery and Dietz[4] a number of profiles 10–170 cm. long, were obtained from depths of 70–330 m. at different places in the Dead Sea during December 1941. It was found that the thickness of the mud layer covering the surface of the bed of the Sea varies in different places from a few centimetres to more than 170 cm. In one place about 6 km. south-west from the northern shore, a profile 170 cm. long was obtained from a depth of 100 m. On dissecting the profile longitudinally, a beautiful 'spectrum of layers', of different colours—black, dark-blue, grey, brown, and white—was revealed (Fig. 1). It is interesting to note that the zones of sedimenta-



'SPECTRUM' OF LAYERS OF A PROFILE 170 CM. LONG OBTAINED FROM THE BOTTOM OF THE DEAD SEA AT A DEPTH OF 100 M.
(*a*) 6–32 cm. (*b*) 32–58 cm. (*c*) 58–85 cm. (*d*) 85–110 cm. (*e*) 110–139 cm.

tion, though distinctly seen, form no seasonal repeat pattern, as, for example, the annual rings of trees.

Thirteen bed samples from six different places were inoculated into enrichment cultures for ten groups of aerobic bacteria and eight groups of anaerobic bacteria. The media was prepared in 25 per cent salt, Dead Sea water (s.g.1·1875) and Dead Sea water (s.g.1·227).

Out of the ten physiological groups of aerobic bacteria growing in 25 per cent salt, thiosulphate-oxidizing and cellulose-decomposing bacteria were found. However, it must be noted that bacterial growth was seen in the enrichment cultures containing kerosine and petroleum as the only source of carbon. In the remaining cultures rich, unspecific growth of bacteria could be seen. In Dead Sea media (s.g.1·1875) thiosulphate-oxidizing bacteria were found and rich growth of unspecific bacteria. The growth in Dead Sea water (s.g.1·227) was slight. Denitrifying bacteria grew in the three different concentrations.

Out of the eight groups of anaerobic bacteria very active lactose- and glucose-fermenting organisms were found at a concentration of 25 per cent salt.

Full details will be published elsewhere.

B. ELAZARI-VOLCANI.

Daniel Sieff Research Institute,
Rehovoth, Palestine.
May 14.

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Sprouting of Potato Tubers

IN an earlier communication[1] reference was made to a U.S.S.R. war-time expedient, namely, accelerated sprouting of potato tubers, which followed the removal of the periderm. This procedure could perhaps be best understood in the elucidation of sprouting itself. The contrasting concepts of changes in oxygen pressure and membrane permeability advanced by some American and Russian workers (private communication from Sir John Russell) register merely the *pulse* of metabolic changes rather than any specific physiological reactions.

Recognizing (1) the accelerator (phyto-hormone, ethylene) as an essential constituent in many phases of plant life[2], and (2) the evolution of the accelerator by the degradation of the inhibitor (blastokolin, maleic acid)[3], I suggest the following scheme as representing accelerated sprouting. The inhibitor ensures dormancy by suppressing enzymic activity (glutathione and consequently glyoxalase and the anaerobic glucose degradation, as well as the activities of succino-dehydrogenase and papain, extending to proteins with fixed SH-groups[4]). The removal of the protecting skin accelerates respiration and enzymic activity, such as oxidative and hydrolytic processes, inducing the transition of the inhibitor to the accelerator, that is, fission of maleic acid into ethylene and carbon dioxide. Ethylene is evolved during ripening or the maturity period, gradually fading towards senescence. Its function appears to be dual. In the food-storing portion of the tuber it accelerates ripening by converting the starch granules into reducing sugars, and the insoluble pectin substances, principally protopectin, into a soluble form[3]. This is apparently accomplished by increased respiration, the selective activation of protoplasmic streaming and amylase, perhaps by the ready adsorption of ethylene by lyophilic colloids and consequent increased cell permeability. These changes exert a protective action on vitamin C and glutathione, while in other phases of plant development they lead to the degradation of proteins, fats and chlorophyll. However, on embryonic development ethylene has an inhibiting effect, suppressing the sprouting of potatoes and germination of seeds. This effect is temporary and apparently narcotic in nature, the germination proceeding unimpaired on removal of the gas[3]. Parallel with ethylene though not necessarily concurrently, other phyto-hormones, such as hetero-auxin and auxins, make their appearance, the former by the degradation of proteins and tryptophane, and the latter in the course of carbohydrate metabolism.

Sprouting coincides with tuber senescence, at which stage the nutrients, now made available, the physico-chemical reactions specific to colloids, as well as photosynthesis, all combine in forming a basis for the plant's morphological development. In this the alkaloidal glycoside solanine[5] plays a significant part, constituting apparently an intermediate stage between the carbohydrates and chlorophyll. The propagation of potatoes from excised 'eyes' and acceleration of sprouting following the skin removal point to the close association of the inhibitor with solanine; both are preponderantly concentrated in the 'eyes', though not entirely absent from the food-storing portion and skin of the tuber.

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Manchester, 16.

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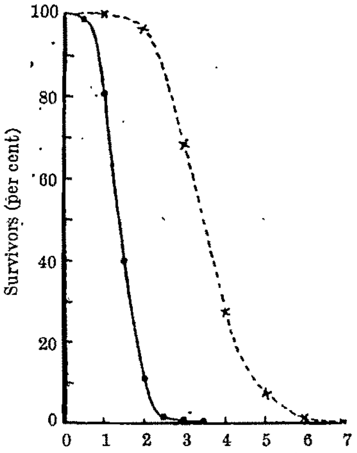
Influence of Colchicine Alone and Combined with X-Rays on Paramecium

THE influence of colchicine on cell division is now assumed generally as stoppage or freezing of mitosis; while Dustin and his collaborators supposed that colchicine stimulates mitosis. In spite of a large number of experiments on different organisms, the literature accessible to us failed, however, to disclose data relating to the influence of colchicine on Protozoa. We only found a short reference concerning the influence of colchicine on Paramecium[1].

To elucidate the production of division under the influence of colchicine we have carried out experiments on *Paramecium caudatum*. The use of this organism possesses several special advantages: (1) The dose of colchicine can be administered more uniformly to Protozoa than to other types of organisms, since every cell is uniformly immersed in the test solution. (2) The effect of the drug can be followed individually on a single cell, allowing precision in observation impossible on other test organisms. (3) Variations in the division rhythm are easily discerned and can be expressed in quantitative terms. (4) Contact with colchicine can be maintained uniformly for as long as is desirable and can be broken off at will by transfer of the organism to a normal milieu. (5) Colchicine can be readily combined with other treat-



Full line, treated in advance with colchicine; broken line, normal paramecia.

ments such as X-rays, As_2O_3, etc., either simultaneously or in succession.

The irradiation was carried out by means of a demountable X-ray tube which was operated at a tension of 18·5 kV. and 15 mA. using a copper anticathode. The window consisted of an aluminium foil of 30 μ thickness. The X-ray intensity at the distance of the irradiated object was 80,000 r./m.

Paramecia were cultivated in a mixture of two thirds standard hay infusion and one third soil extract prepared according to Pringsheim. From this basic medium three concentrations of colchicine were prepared (colchicine crystalline preparation, British Drug Houses, Ltd.). The solution designated C_1 contained 0·0005 per cent, C_2 contained 0·00025 per cent, and C_3 contained 0·000125 per cent of colchicine.

Single individuals from a given clone were transferred to fifteen drops of test solution and cultivated in the chamber of hollow-ground glass slides. To prolong the time between two divisions, the cultures were maintained at a relatively low temperature (20° C.). After twenty-four hours the number of animals in each chamber was counted and all transferred to fifteen fresh drops of the same medium for another twenty-four hours. The results of fifty experiments of this kind are summarized in the accompanying table. It is evident that C_1 concentration is lethal; on the other hand, C_2 concentration and, in more marked degree, C_3 concentration exert a stimulating effect on cell division. In C_3 solution the division rate is significantly greater than in the control medium.

For experiments with colchicine combined with X-rays, the Paramecia were maintained for forty-eight hours in the colchicine solution, then transferred to normal culture medium and therein irradiated. The irradiation was carried out in a hanging drop through a mica cover glass.

The lethal dose range in these experiments lies between 50,000 and 350,000 r., the half-value dose lying between 100,000 and 150,000 r. In earlier papers we showed that the lethal dose for normal Paramecia fluctuated between 200,000 and 700,000 r., the half-value doses lying between 300,000 and 250,000 r. These experiments show that the immediate lethal dose is considerably smaller—about 50 per cent—for Paramecia which received prior treatment with colchicine (see graph).

Influence of colchicine on the division rate of Paramecium

Counted after	Number of individuals in the different solutions			
	Solution C_1	Solution C_2	Solution C_3	Control
0 hr.	50	50	50	50
24 hr.	0	114	130	74
48 hr.	0	450	609	275

In experiments with arsenic acid (As_2O_3) it was shown that the colchicine pre-treated organisms do not differ from the controls in their susceptibility to arsenic. Colchicine pre-treated organisms were not different also from the controls in sensitivity to ultra-violet rays.

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July 18.

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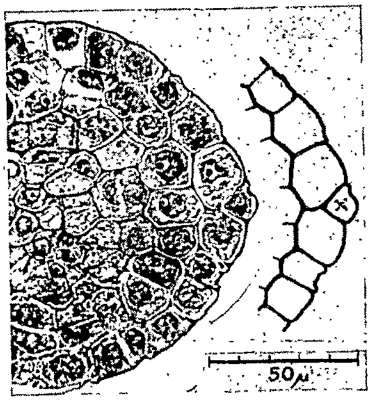
Dustin, A. P., *C.R. Ass. d. Anat.* (Bâle, 1938).
Back, A., *C.R. Soc. Biol.*, **131**, 1103 (1939).
Halberstaedter, L., and Back, A., in the press.

A Periclinal Division in the 'Dermatogen' at the Growing Point of Couch Grass, *Agropyron repens*, Beauv.

Except at the edges of young leaves, the 'dermatogen' cells in Dicotyledon shoot growing-points normally only divide anticlinally, but in many Monocotyledons they also divide periclinally where primordia are arising. That occasionally they may divide periclinally independently of leaf initiation was shown in a previous communication[1]. Since then, Miss E. A. Bindloss has mentioned (in a letter dated March 3, 1941) that she has also observed a similar situation in her material of maize plumules. It now seems that earlier, in Triticum, Rösler[2] had noticed a single example of dermatogen cells dividing periclinally without being involved in the production of a primordium. The following interesting case now deserves recording.

The photograph and accompanying cell-wall drawing show part of a transverse section of the growing point of couch grass, *Agropyron repens*, Beauv., taken



220 μ below the extreme tip, with a peculiar small cell (x) partly embedded in the dermatogen. The cell illustrated is not an isolated one, but is a member of a file about 330 μ long, commencing at about 150 μ from the tip and containing about thirty cells similar to the one photographed.

Presumably a single dermatogen cell divided periclinally, and subsequent transverse divisions have resulted in the file observed (five cell generations = 32 cells). At both ends of the file the last cells have become separated from the rest and have also sunk into the dematogen layer as though they have been accommodated by the adjustment of the neighbouring cells. At three points down the file, the cells on each side have divided periclinally where primordia are being initiated, but in no case are there periclinal walls in the cells of the file.

It would seem, therefore, that even in Angiosperms, isolated dermatogen cells may occasionally divide periclinally, and that the example described above represents one stage which may follow such a division, an example of which was previously seen in a single cell in maize.

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[1] Sharman, B. C., NATURE, 146, 775 (1940).

[2] Rösler, P., *Planta*, 5, 28 (1928).

The Highland Border Series in Bute

DURING a recent examination of a disused quarry ituated 750 yards west 10° south of Rothesay Pier, nd 1,200 yards north 15° west of the north end of he Kirk Dam, a band of limestone was observed on he north side of a broad east-west Permo-Carbonierous quartz-dolerite dyke. The limestone was ecorded by Gunn in 1884 on a 6-inch to the mile anuscript map of the Geological Survey, but it is ot shown on the published 1-inch to the mile map Sheet 29, 1892). It does not appear to have been escribed in geological literature, although it may ave been seen by Nicol[1], who made a passing eference to limestone in this part of the island.

The limestone, a fine-grained greyish-black type, ccurs in a band 7 feet thick, dipping south-south-east t 55°. It is associated with grey and black, someimes graphitic, cleaved shales containing further hinner beds of limestone. These shales form part f a band which has been traced for at least three iles to the south-south-west, parallel to and about alf a mile west-north-west of the Highland Boundary ault.

To the north-west the shales are bounded by a ide outcrop of grits which can be correlated with he Leny Grits of the Dalradian succession of Perthhire. On the evidence of graded bedding the grits an be demonstrated, at numerous localities, to resent their younger side to the shales, with which hey appear to be interbedded ; but this last point quires further investigation.

In the ground to the north-west the grits are llowed by a belt of phyllites which cross the island om Kames Bay to Etterick Bay. These form the uth-westerly continuation of the Dunoon phyllites nd like the latter contain thin beds of limestone. hey can be shown by means of graded bedding, as as been pointed out by Dr. W. J. McCallien[2], to be older than the grits to the south-east. They would seem, therefore, to lie on a different horizon from the Rothesay limestone and shales, from which, moreover, they differ considerably in character. Recent work suggests that the Kames Bay phyllites are also older than grits to the north-west and that they consequently occupy the core of an anticline.

On the basis of associated rocks, stratigraphical and structural position, the Rothesay limestone is regarded by the writer as equivalent to the Leny limestone at Callander, in which Dr. J. Pringle, who has since examined the Rothesay exposures and concurs in this view, has discovered fossils of Middle Cambrian age[3]. The Leny limestone has been correlated with the well-known Margie limestone forming part of the Highland Border Series of Angus and Kincardine[4]. This series includes rocks of both Cambrian and Ordovician age, and occupies a number of lenticular outcrops near the Highland Boundary Fault from Stonehaven to Arran. The Rothesay limestone and shales are considered to form a hitherto unrecorded example of one of these lenticles. When an opportunity for further search offers, it is hoped that they will yield, like the Callander rocks, fossils of Cambrian age.

The above observations were made during part of an investigation carried out with the aid of a grant from the Clough Research Fund.

J. G. C. ANDERSON.

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July 31.

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[1] Nicol, J., "Guide to the Geology of Scotland", 218 (Edinburgh, 1844).

[2] McCallien, W. J., *Trans. Buteshire Nat. Hist. Soc.*, 12, 91 (1938).

[3] Pringle, J., *Rep. British Assoc.*, 252 (1939).

[4] Pringle, J., *Trans. Geol. Soc. Glasgow*, 20, 136 (1941).

Sulphur Springs of Cyprus

THE presence of sulphur springs in the island of Cyprus is a well-established fact, and several, such as the springs of Kalopanayotis and Ayoi Anargyroi, are widely used for treatment of internal and external diseases. It is therefore somewhat surprising that apart from casual samples sent for analysis abroad, no systematic survey has been undertaken so far. The handbook of R. Storrs and B. J. O'Brien, where a page on mineral springs has been reprinted without alteration from the earlier work of H. C. Luke and Jardine, contains but a few rather misleading data.

Some time ago I had the opportunity of investigating, on behalf of the Geophysical Institute of Cyprus, eight sulphur springs located at widely separated points of the island. These springs are only a part of the total occurrence, and the survey cannot, therefore, be regarded as exhaustive. It is nevertheless possible to draw certain conclusions inasmuch as the investigations covered the main sulphur spring localities of the island. They reveal the existence of two types of sulphur springs with distinctly different chemical composition, originating in different geological formations.

The springs of one group emanate from the igneous rocks of the Troodos range, mainly along the andesitic pillow lava zone. The springs of the second group have their source in the miocene Idalian formation, with their massive gypsum deposits.

The waters of the first group are characterized by their strong alkalinity and comparatively moderate salinity. Free sulphuretted hydrogen is not present, and although the water tastes strongly, no smell could be detected. It can be assumed that the sulphide is present as sodium sulphide, and this would also be in accordance with the *p*H value resulting from the hydrolytic dissociation of the corresponding amount of sulphide:

$$Na_2S + H_2O = NaSH + NaOH.$$

The handbook refers to sulphuretted hydrogen in the water of Kalopanayotis, and remarks that the chief salts of the springs are the chlorides of sodium and magnesium, sulphate of magnesium and carbonate of lime.

Analytical data for these springs of this first group are shown in Table 1.

TABLE 1

	Ayiasmata	Pelendri	Tiochou	Psammiacon
Temperature	23° C.	25·5° C.	19·7° C.	20·5°C.(Sept. midday)
Transparency	clear	clear	clear	clear
Colour	colourless	colourless	colourless	colourless
*p*H	11·3	11·4	11·6	11·7
KNO_3 (mgm./l.)	1·5	—	—	—
KCl	4·5	9·1	26·0	61·5
NaCl	335·3	207·0	722·6	698·2
Na_2S	13·1	23·4	56·1	63·1
Na_2SO_4	31·3	29·1	43·5	36·9
Na_2CO_3	31·5	55·5	161·0	126·1
$CaSO_4$	256·3	26·6	9·2	5·8
$MgSO_4$	0·9	—	—	—
$Al_2(SO_4)_3$	1·5	—	1·1	1·1
Total Salines	677·9	351·3	1,019·5	992·7
H_2SiO_3	10·1	25·6	64·4	69·6
HBO_2	2·9	4·1	11·2	7·8

The waters of the second group are slightly acid (almost neutral), and are nearly saturated with gypsum. The fact that these springs have their source in the gypsum rocks of the Idalian series explains satisfactorily the high calcium sulphate content. The water contains sulphuretted hydrogen as well as carbonic acid and bicarbonate, and smells and tastes of hydrogen sulphide. The presence of sulphide is probably due to the reduction of calcium sulphate with subsequent freeing of sulphuretted hydrogen through action of the carbonic acid.

Analytical data for the four springs of the second group are given in Table 2.

TABLE 2

	Lethimbou	Ayoi Anargyroi	Myrtos	Mathi
Temperature	20·2° C.	20·5° C.	20·0° C.	19·5° C.(Sept. midday)
Transparency	very slight turbidity	clear	clear	clear
Colour	faint yellow	faint yellow	colourless	colourless
*p*H	6·9	7·0	6·9	7·1
KNO_3 (mgm./l.)	—	0·5	1·7	—
KCl	2·8	13·7	21·8	6·9
NaCl	115·7	163·8	493·8	103·4
$CaSO_4$	2,189·3	2,075·3	2,104·7	2,032·0
$Ca(HCO_3)_2$	105·3	—	—	45·4
$Mg(HCO_3)_2$	267·6	141·5	168·2	291·5
$Fe(HCO_3)_2$	2·6	2·5	2·4	traces
$NaHCO_3$	—	272·9	234·8	—
$MgSO_4$	—	277·5	219·0	—
Total Salines	2,683·3	2,947·7	3,246·3	2,479·2
H_2S	13·6	19·0	9·9	2·7
CO_2	81·7	59·7	46·6	56·3
H_2SiO_3	44·5	63·2	64·6	52·9
HBO_2	1·2	4·9	2·4	3·6

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Temperature of Flame Gases

IN internal combustion engines the temperature of the flame gases is inferred from pressure and volume measurements and is therefore a measure of their mean molecular translational energy. In open flames, however, the temperature is generally assumed to be that acquired by a thermometric substance immersed in them (after correction for radiation loss). But the temperatures shown in the table below indicate that this requires further consideration. These temperatures were measured by means of very fine platinum-rhodium wires (0·0005 in. diameter) and quartz-covered platinum-rhodium wires (0·0005 in. overall diameter) during the pre-pressure period in large closed-vessel explosions[1]. No correction for radiation loss has been applied to them. The combustible gas-air mixtures were at atmospheric pressure and were thoroughly mixed before ignition by an electric spark.

Percentage combustible gas in mixture	Temperature (°C.) measured by		
	Quartz covered wire	Plain wire	Difference
20% CO*	1,210	1,420	210
25% CO*	1,350	1,650	300
29·6% CO*	1,470	1,850†	380
55% CO*	1,350	1,350	0
60% CO*	1,260	1,260	0
7·5% CH_4	1,250	1,440	190
8·5% CH_4	1,320	1,600	280
9·47% CH_4	1,380	1,730	350

* The carbon monoxide contained 1% hydrogen.
† Slightly extrapolated.

There would have been little or no difference between the temperatures measured by the two wires had the flame gases been just hot normal gases. But as has been shown, flame gases contain a long-lived latent energy (probably resident within a proportion of the newly formed tri-atomic molecules) and in virtue of this an abnormal dissociation may obtain in them. It would appear, therefore, that a thermometric substance immersed in flame gases may be heated as a result of:

(1) their true temperature (proportional to their mean molecular translational energy),

(2) the unloading of latent energy upon its surface, and

(3) recombination of the abnormally dissociated products upon its surface, provided that this is of a type (like platinum) which promotes surface combustion.

The large differences between the uncoated and quartz-coated wires must be due mainly to (3). In the case of the 55 per cent and 60 per cent carbon monoxide mixtures it will be noted that there is no difference between the temperatures measured by the two wires, and in these cases it must be supposed that the abnormal dissociation is suppressed by the large excess of carbon monoxide.

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August 4.

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[1] "The Abnormality of Flame Gases", *Proc. I. Mech. Eng.* (in press) and other papers referred to therein.

SABETHINE MOSQUITOES OF THE AMERICAS

By DR. JOHN SMART

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YELLOW fever exists in two forms which differ epidemiologically, the well-known classical form of the disease and the more recently discovered jungle yellow fever. In both cases the virus is transmitted to man by the bite of an infected mosquito.

In the ordinary form of yellow fever the mosquito acquires the virus by biting a man suffering from the disease. The vector of this form of the disease is the tropicopolitan tiger mosquito, *Aëdes* (*Stegomyia aegypti* (Linn.) (= *Stegomyia fasciata* (Fabr.)), which is a domestic species in that it tends to breed in collections of water accidentally or deliberately created by man in and around his dwellings. Several other species of mosquitoes, mostly, but by no means exclusively, of the same genus, are known to be capable of transmitting the virus under experimental conditions, but, for various reasons, they were, until recently, not regarded as of any significance as vectors in a state of Nature. Effective means of controlling the tiger mosquito were evolved and the Rockefeller Foundation[1], which carried out a vast amount of work on yellow fever, stated at one time that, prior to 1929, it was believed that it might be possible to eliminate the disease completely. In addition to the control of the disease by the application of anti-mosquito measures, successful vaccine treatment has now also been evolved.

In 1932, however, as reported by Soper and his co-workers[2], a different epidemiological type of yellow fever broke out in a locality in Brazil. In this outbreak, and in others that followed in other localities, no trace of the tiger mosquito could be found; the outbreaks occurred in rural localities in forest areas. In these outbreaks man was generally infected only while in contact with the jungle or forest, and this new form of the disease became known as jungle yellow fever. A search had to be commenced at once to discover the actual or probable vectors of the virus in this new form of the disease as well as the source whence the virus came at the commencement of these isolated outbreaks.

Prior to the discovery of Stokes and his co-workers[3] in 1927 that the yellow fever virus could be successfully transmitted to the rhesus monkey, no experimental animals or wild animals capable of harbouring the virus were known. Since that date it has been discovered that a number of rodents and other animals react to and can harbour the virus. These discoveries simplified greatly the search for new mosquito vectors by providing a means whereby the presence of the virus in a mosquito could be detected by direct biting experiments and by indirect inoculation methods. They also pointed to the animals of the jungle and forest as a potential reservoir for the virus from which it could periodically escape into human communities by the bite of some jungle mosquito that had previously bitten an infected ungle animal.

To cut a long and exciting story short, yellow fever virus was detected in wild animals and, in 1928, Shannon and his co-workers[4] discovered the presence of the virus in wild-caught jungle mosquitoes. These workers were able to demonstrate actual transmission of the virus to monkeys by two species of wild-caught jungle mosquitoes, *Aëdes* (*Finlaya*) *leucocelænus* D. and S. and *Hæmogogus capricornii* Lutz, and, in addition, they proved the presence of the virus in a number of species of jungle mosquitoes belonging to the group known as the Sabethine mosquitoes.

The Sabethine mosquitoes are mostly rain forest insects and, owing to their habitat, relatively few specimens are found in collections unless they have been especially sought. The information about them was somewhat sparse, and Shannon and his co-workers[4] had to admit that it was "impracticable during this preliminary study to separate the sabethines by species". Edwards[5], in 1932, catalogued 109 species from the Americas and indicated that information about the larvæ was available in the case of fifty-one species. It was obvious that a monographic treatment of the group was urgently needed.

It is appropriate that this need should have been appreciated, and the work carried out to fill it, by two workers in Brazil. J. Lane (Istituto de Higiene da Universidade de São Paulo) and N. L. Cerqueira (Serviço de Estudos e Pesquisas sobre a Febre Amarela) have recently published a lengthy paper —"Os Sabethineos da America (Diptera, Culicidæ)". (*Arqu. Zool., Estado São Paulo*, 3, pp. 473–849, Oct. 1942, in Portuguese)—in which they have provided a systematic revision of the group, amply illustrated and containing a considerable amount of information on the biology of its members.

Lane and Cerqueira deal with 150 New World species and one variety; they describe the females of 147 species, the males of 122, the pupæ of fifty-three and the larvæ of eighty-nine species. Thirty-two of the species are described as new. Full synonymy is given with copious notes on distribution; keys to the females, males, pupæ and fourth-stage larvæ are provided. Altogether there are 219 pages of letterpress and 76 pages of figures, of which there are a total of 450. The work involved much breeding of species in the laboratory, and some of the species described are known from adults bred from larvæ, but have not yet been caught on the wing in a wild state. The data on distribution were greatly helped by the examination of some 260,000 specimens of Sabethines collected by the Serviço de Febre Amarela and later by the Serviço de Estudos e Pesquisas sobre a Febre Amarela organized by R. C. Shannon.

Edwards[5] regarded the genera that constitute the Sabethines as a group within the tribe Culicini of the sub-family Culicinæ of the family Culicidæ. Lane and Cerqueira follow certain other authors and treat the group as a tribe, Sabethini, distinct from, but of the same taxonomic status as, the Culicini. They distribute the American species among five genera and seventeen sub-genera. The fifty-nine species of Old World Sabethines catalogued by Edwards[5] in 1932 were distributed among three genera and six sub-genera. None of the genera is common to both the Old and New Worlds.

The adult Sabethines have long been known for the beauty of their coloration and ornamentation, and of the different genera the typical genus Sabethes, which is confined to the Neotropical region, is probably the most familiar. In this genus the usual coloration is a mixture of dark blue and shining white, but their most remarkable feature is the 'paddles' that are borne on the mid-tibiæ and sometimes on the fore- and hind-tibiæ as well. These 'paddles' are formed by a dorsal and a ventral fringe of long erect scales which may extend beyond the tibiæ on to the upper part of the tarsus. The function of these paddles remains uncertain though they undoubtedly draw the eye to the individual mosquito when it is in flight.

The adult Sabethines are diurnal and the females of most species bite both man and horse; there is a record of a female biting a lizard. The males are not known to swarm, and Lane and Cerqueira suggest that the sexes may be attracted to each other by their brilliant coloration in daylight. The male of *Limatus durhami* Theob. has been observed resting on a tree trunk with the proboscis bent upwards, thus exposing to view a bright blue patch of scales on the underside; it is suggested that many of the other forms of ornamentation may be correlated with some habit that brings them into use for purposes of display.

The larvæ are found in the water gathered in the axils of the leaves of various water-holding plants (Bromeliaceæ, Araceæ, Muscaceæ, etc.), in water gathered in fallen leaves, husks of fallen fruits, tree holes, bamboo holes and other similar water-holding situations that abound in the tropical rain-forest. *Limatus durhami* appears to be unique in that it breeds in water collected in tins and broken vessels on abandoned rubbish tips as well as in water in fallen leaves; though thus occurring in peri-domestic breeding places, this species does not occur in sufficient numbers to become a pest. Some species are restricted to special breeding habitats. *Weomyia (Menolepis) leucostigma* (Lutz) breeds only in the axils of the leaves of 'tabua' (Typhaceæ), and the larvæ of *Weomyia (Dendromyia) melanocephala* D. and S. are found in the leaf-axils of 'tabua', 'taioba', 'tinhorão' (Araceæ) and occasionally in the internodes of bamboo. The insectivorous plants that hold fluid in their leaves harbour the larvæ of some species.

The abundance of the species does not seem to vary much with the seasons as is the case with Anophelines and Culicines in the same district. Their seeming rarity is, of course, obviously due to the wide dispersal of their breeding places. Their total numbers over a wide area are probably very large, exceeding the populations of other mosquitoes that happen to be restricted to a domestic or semi-domestic breeding habitat, though these latter species might appear in considerable concentrations in some small settlement in the jungle and so give the impression of being present in much larger numbers than the jungle-breeding Sabethines.

Sanitarians and others concerned with the battle against yellow fever should now find themselves armed with a satisfactory tool for identifying the Sabethine mosquitoes of the New World, while systematists interested in the Culicidæ will thank the authors for their services in collecting the available information, adding much that is new thereto, and in presenting it in a clear and pleasing format.

The authors have expressed their intention to deposit paratypes of certain of their new species and other material in the British Museum (Natural History) as a return for the assistance rendered to them in the prosecution of their work by the late Dr. F. W. Edwards of the Department of Entomology.

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[1] The Rockefeller Foundation, a review for 1936 by Raymond Fosdick, President of the Foundation, 1937, pp. 13–17.

[2] Soper, F. L., Penna, H. A., Cardoso, E., Serafim, jun., J., Frobisher, jun., M., Pinheiro, J., *Amer. J. Hyg.*, 18, 555 (1933).

[3] Stokes, A., Bauer, J. H., Hudson, N. P., *J. Amer. Med. Assoc.*, 90, 253–254 (1928).

[4] Shannon, R. C., Whitman, L., Franca, M., *Science*, 88, 110 (1928).

[5] Edwards, F. W. 1932, Genera Insectorum, Fasc. 194, Diptera, Culicidæ 258 pp.

FORTHCOMING EVENTS

Saturday, September 4

BRITISH PSYCHOLOGICAL SOCIETY (at Tavistock House, Tavistock Square, London, W.C.1), at 2 p.m.—"On the Problem of Representative Sampling of the Population".

Thursday, September 9

PHYSICAL SOCIETY (COLOUR GROUP) (in the Lecture Theatre of the Science Museum, Exhibition Road, South Kensington, London, S.W.7), at 2.30 p.m.—Mr. J. B. Reid: "A Review of the Theory of Colour Photography".

Friday, September 10

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Prof. Svein Rosseland: "The Pulsation Theory of Cepheid Variables" (George Darwin Lecture).

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER IN MATHEMATICS in the Coventry Technical College—The Director of Education, Education Offices, Coventry (September 7).

ANIMAL HUSBANDRY OFFICER—The Secretary, Norfolk War Agricultural Executive Committee, Sprowston, Norwich (September 11).

LECTURER IN MINING (COAL)—The Secretary, The University, Edmund Street, Birmingham 3 (September 18).

LECTURER IN EDUCATION, PSYCHOLOGY AND SOCIAL PHILOSOPHY—The Principal, South-West Essex Technical College and School of Art, Forest Road, Walthamstow, London, E.17 (September 10).

PRINCIPAL OF THE MUNICIPAL TECHNICAL COLLEGE—The Director of Education, Education Office, St. Helens (September 11).

TEACHER OF METALWORK in the Junior Technical School—The Principal, Technical College, Church Street, Barnsley (September 13).

ASSISTANT MASTER TO TEACH MATHEMATICS in the Junior Technical School and to part-time students up to Higher National Certificate standard, at the Willesden Technical College, Denzil Road, N.W.10—Dr. E. Davies, Education Office, Vernon House, Willesden Lane, London, N.W.6 (September 15).

HEAD OF THE ENGINEERING DEPARTMENT of the South-East Essex Technical College and School of Art, Longbridge Road, Dagenham—The Chief Education Officer, County Offices, Chelmsford (September 18).

INSPECTOR OF MINING SUBJECTS (Reference No. C.1843), and a WOMAN INSPECTOR OF TECHNICAL TRAINING FOR WOMEN (Reference No. C.1844)—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Alexandra House, Kingsway, London, W.C.2 (quoting the appropriate Reference No.) (September 20).

PHYSICIST TO THE RADIOTHERAPY DEPARTMENT—The Secretary, University College Hospital, Gower Street, London, W.C.1 (September 27).

CHAIR OF SOCIAL MEDICINE—The Secretary, The University, Edmund Street, Birmingham 3 (March 1).

LECTURER IN THE DEPARTMENT OF ELECTRICAL ENGINEERING of the Cape Technical College, Capetown, South Africa—The Secretary, Overseas Manpower Committee (Reference 1021), Ministry of Labour and National Service, Alexandra House, Kingsway, London, W.C.2.

BIOCHEMIST—The Secretary, Institute of Research for the Prevention of Disease, 117 Grove Street, Liverpool 7.

BIOLOGY MASTER, mainly for a new Pre-Agricultural Course in the Day Technical School—The Principal, Maidstone Technical Institute, Tonbridge Road, Maidstone.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

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Other Countries

Annals of the Carnegie Museum. Vol. 29, Art. 16: New Neididae (Hemiptera) from South America, with Notes on some Little-known Species. By Halbert M. Harris. Pp. 443–450. (Pittsburgh, Pa.: Carnegie Museum.) [98

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THE CHALLENGE OF PEACE

IN his address last year at the Conference on Mineral Resources and the Atlantic Charter, arranged by the British Association, Sir Stafford Cripps struck a note that has been reflected more frequently in the speeches of American leaders than those in Great Britain. "We are fighting," he said, "for a moral and not merely for a material issue. Though our plans must be scientifically prepared there must be behind them the inspiration of our most deeply religious convictions." That note has been struck repeatedly in the speeches of Mr. Henry Wallace, of President Roosevelt and of Mr. J. G. Winant. It was clearly to be heard in the address broadcast by the Archbishop of Canterbury during the Day of National Prayer held on September 3 which marked the fourth anniversary of the outbreak of the War. Dr. Temple stressed the importance and urgency of preparedness for the tasks of peace, in themselves no less arduous than those imposed by war. The duties which will face us then, he said, will demand a spiritual approach.

The topic forms a main theme of Mr. H. Agar's recent book "A Time for Greatness", and in a different guise it is encountered in an article in the American periodical *Fortune*. That article touches simultaneously on a note that was very marked in the closing sessions of the House of Commons before the recess. The very success of the War in recent months and the growing conviction that victory was coming into sight had aroused concern as to our readiness to meet the problems of peace, a concern that was obviously fostered by the Government's refusal to take decisions and announce its policy on matters which in the Uthwatt Report, the Barlow Report or the Scott Report had long been before it. "The real danger to American civilization," wrote the editor of *Fortune*, "is a danger not of war but of peace. It is the danger that we may prove unable to make of peace a higher and more effective expression of that civilization than we have made of war. The danger is that we shall find no national purpose—except war—capable of evoking our greatest energies."

Conditions differ in the two democracies, but within the House of Commons and in the country at large there are many who would unhesitatingly subscribe to this new declaration of the need for a moral equivalent of war as being fully as pertinent to Great Britain as to the United States. The article sets fairly before the American reader the three great challenges to American civilization which challenge Britain no less: the threat of war to civilized life and the need to replace it by some such methods as implementing and making permanent the United Nations, an Anglo-American union, or the method of international law; the challenge of the machine and the solution of the problem of distribution which holds up the raising of standards of living throughout the world; and the philosophical challenge of the meaning of life—the rediscovery of faith.

These great postulates are challenges which know no national frontiers. They reach to the foundations of our common civilization, and in meeting them out of the richest of their common experience and heritage, it may well be that Britain and America may find or renew a spiritual unity even closer than the physical unity which has brought them in sight of victory. Certainly such a spiritual unity affords the only enduring basis for whatever constitutional developments may flow from turning to the service of the needs of rehabilitation and reconstruction the agencies which we have had to bring into being for the effective service of the war effort.

While we may well welcome the evidence that Americans are being called by their own countrymen to fundamental thinking on the moral and vital issues which must be faced if they and we are to win the peace, there is no less need for fundamental thinking on this side of the Atlantic. Mr. Lionel Curtis's "Faith and Works" is an honest attempt to elucidate these issues from the British side, emphasizing the moral basis of any attempt to eliminate world war and the minimum constitutional changes which in his view would be sufficient for that purpose*.

Mr. Curtis takes up the position which Lord Lothian took up in his Burge Lecture in 1935, that the essential cause of world wars is the fragmentation of human society into more than sixty sovereign States. His basic point is that we should recognize that Great Britain standing alone is no longer able to ensure the security of the Commonwealth as a whole, or even that of the British Isles. It can no longer provide the security which the United Kingdom was able to provide in the nineteenth century when, as Prof. E. H. Carr observes, "the British fleet not only guaranteed immunity from major wars but policed the high seas and offered equal security to all".

There can be no doubt that Mr. Curtis is right in directing attention to this fundamental, if unpalatable, fact, though recognition of this and also of the truth of Washington's words, which he also quotes, "Influence is not government", does not necessarily lead to the view that the problem of security for the United Nations will only be solved when the peoples of the American and British Commonwealths have merged their resources under one organic government charged with their common defence. Mr. Curtis does not go all the way towards federalism, but his argument carries him far along the path towards the formulation of definite constitutional proposals as opposed to the functional growth which has been advocated by Prof. Mitrany in a recent paper issued by the Royal Institute of International Affairs. Mr. Curtis, however, forces us to face the fact that the Government of Great Britain will not be in a position to give again to the peoples of the occupied countries like Belgium, Holland and Norway such a guarantee as we gave to Belgium. We can only invite them to join in discussions as to how the burden of a common defence could be shared.

Proposals for the re-establishment of European and of world order and for the maintenance of peace must start from this point. Mr. Curtis's proposals are equally inspired by the belief that no duties should be entrusted to a central government which could be discharged effectively by a local or regional government, but that where duties are entrusted adequate power should also be provided. None the less, he strays a long way from the functionalism or the evolution and adaptation to the purposes of peace of the organisms set up to serve our war needs which now seems to be the main approach to the problem favoured by those actively concerned with the task of reconstruction.

Mr. Curtis insists that peace and social reform are two inseparable ends. Social reform and a higher standard of life cannot be achieved unless peace is firmly established among the nations; and we cannot establish peace unless national governments are really equipped to cope with social reform. His argument that the real obstacle to social reform is that national governments have so much to do that they cannot keep pace with the changes that a mechanized age demands, finds a pertinent illustration in the present impasse in Great Britain arising out of the Government's delay in implementing the decisions and policy called for in the field of physical reconstruction and planning. If it were possible to relieve national governments of the task of maintaining peace and to entrust it to an international government, the pace and efficiency of social reform might reasonably be expected to quicken.

Whether the line between international and national functions can be drawn as clearly as Mr. Curtis suggests is another matter; even in social reform, such matters as health and nutrition can scarcely be determined by independent national action alone. He would leave to the national governments the last word on the incidence of taxation between one citizen and another, on tariffs, on industry and commerce; international government would, however, be given power to make the security of all the nations it has to protect a first charge on all their resources, material and human; the burden of the revenue required for the common defence would be distributed between the nations defended in proportion to their taxable capacity as ascertained by a judicial committee of experts. Beyond this any international government charged with the task of averting war should have the power to hold under its own flag a merchant marine large enough to secure its transport needs in war, and such government should also be given complete control of all aviation between the nations united and charged with the duty of creating an adequate service. Finally, it must have power to control dependencies not ripe for responsible government.

As to the extent of the defence association, Mr. Curtis appears to have in mind one embracing Great Britain and one or more of the Dominions, the United States and the democracies of Western Europe. The international government should, he urges, be responsible, not to national governments but to the peoples they represent. Essentially he argues for an instrument selected and shaped for the particular purpose which it is to serve and free from commitments which might dissipate its energies or confuse the issues. He insists that we should not treat instruments and methods as ends in themselves and lose sight of the ends for which they were devised.

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* Faith and Works. By Lionel Curtis. Pp. vi+120. (London: Oxford University Press, 1943.) 2s. net.

The insistence on moral values and the note of pragmatism which is sounded throughout give Mr. Curtis's pamphlet a real value in discussions on the form which the organization of world government must take. Whether we accept his conclusions or not, he emphasizes some of the realities which must be faced in any solution, and different as are the conclusions he draws from those drawn by Sir Frederick Maurice in his recent study of "The Armistices of 1918" they are a striking complement to the latter. In both, indeed, there is the same note of urgency—Sir Frederick Maurice's first point is that a request for an armistice may come as unexpectedly as any event in war—and both insist on the need for foresight and preparation and the necessity of maintaining for an indefinite period the power to enforce the will of the United Nations, or in other words to maintain the peace.

Sir Frederick Maurice points out that the preparation necessary if the terms of armistice are to be satisfactory should include arrangements for the effective occupation of enemy territory until satisfactory terms of peace are assured ; and, as corollary to his second conclusion as to the maintenance of effective military force, he points out that it is important that an early decision should be reached as to the size and distribution of the forces which the Allies should maintain. A programme should be prepared for the gradual reduction of our forces and announced to the Services at the earliest possible date, and no political or private interests should be allowed to interfere with the orderly execution of this programme.

It may well be asked whether such a programme can be drawn up except on the basis of such discussions as are envisaged by Mr. Curtis. The fatal mistake of unilateral disarmament must not be repeated, and the indispensable measure of agreement on this point between Great Britain, the United States and the U.S.S.R., if not with others of the United Nations, might well be the prelude to some such organization as Mr. Curtis suggests, though probably less formal, and based on governments, not on the individual citizens. Sir Frederick Maurice's third conclusion, that the preparation of terms of armistice, the supervision of the execution of these terms, and the solution of the many and varied problems which will arise after the signature of the armistice raise questions different in nature and kind from those which are brought up by the preparation of treaties of peace, again emphasizes the necessity for formulating plans and reaching agreement on peace aims in advance. Preliminary studies must be made during the War and a nucleus of the necessary organization established.

His final conclusion that the Allies, if they are to secure their declared war aims of disarming the aggressors, must provide themselves with the necessary means, once again emphasizes the necessity not only for adequate force but also for agreement as to its constitution. Here he suggests that air power may provide a solution, and that it should be our object to deprive our enemies of all aircraft, military or civil, and to control their disarmament by an allied air force until such time as more permanent arrangements for the prevention of aggression can be established. He sees in the trial of such an air force composed of contingents of the air forces of the Powers, members of the international authority, to control our enemies in the interval between the signatures of armistices and the ratification of treaties of peace an opportunity to experiment which if successful could be made part of a permanent organization for the preservation of the peace of the world.

There may well be less difference than appears on the surface, therefore, between the proposals of Mr. Curtis and the conclusions reached by Sir Frederick Maurice. The latter is strikingly in line with pronouncements which have already been made by members of the Government in both Great Britain and the United States. In his important Guildhall speech last February Mr. Herbert Morrison contemplated the creation in due time of a genuinely representative world political association. Like all others he emphasized the necessity of any such association possessing a force fully sufficient to achieve its agreed purposes and to restrain those who would impede them, but he spoke also of how constructive and systematic thought on the problems of supply and raw material allocation, of relief and rehabilitation was creating the very stuff and content of post-war international relations. On the American side, Mr. Cordell Hull has been equally explicit as to the necessity for creating some international agency. Again, the American Commission to Study the Organisation of Peace has both recognized the spiritual and ethical basis on which any form of world organization must rest and stressed the necessity for new institutions, world-wide and regional, to perform services which can no longer be left to each State acting as a separate unit.

One well-marked school of thought looks to the development of Europe's public utilities to encourage a fuller sense of Continental unity. Mr. Amery, rejecting the idea of federation for the British Empire, although contemplating some regional or federal developments into larger units by the smaller countries of Europe, looks to closer working arrangements between Britain and the Dominions and the development of the Imperial Conference system. It will not escape notice that Mr. Churchill paused very deliberately for consultations in Quebec before proceeding to the United States on his latest visit to America. If we are to exclude federalism, on defence grounds alone the facts emphasized by Mr. Curtis will compel us to establish some working executive of defence which can scarcely be limited to the Empire, and it will be at least essential for all the British nations to be ready to take commitments in common council.

One suggestion, advanced by Sir Edward Grigg, is for a series of Empire regional councils, but more than this will clearly be required however much such a development might assist us to surmount some of the geographical difficulties. Meanwhile, Mr. Richard Law has hailed the Hot Springs Conference on Food and Agriculture, with its establishment of an interim Commission to carry on its work, as the birth of the United Nations. The United Nations Relief and Rehabilitation Administration is another notable step in the same direction, and in the Combined Raw Materials Board, the Combined Food Board and the Shipping Adjustment Board we have other instruments which may serve as a basis for world co-operation after the War. More is, of course, required. Currency plans are as yet embryonic, and only the most tentative approach has been made to the vast problems of international trade and exchange; and there are no signs at all that anything of the nature of a general staff for peace has yet been set to work in accordance with the important suggestions made last year by the Netherlands Ministers for Economic Affairs and for Colonies.

The arguments advanced by Mr. Kerstens and by Dr. van Mook have lost nothing in weight since last autumn, and though it is clear from Mr. Churchill's broadcast last March that the Government is thinking about these problems in general terms the time is fast approaching when some more definite assurance may well be demanded that the Government is ready not only with the armistice plans discussed by Sir Maurice Hankey but also with concrete proposals for dealing with the grave problems of order and reconstruction which must be handled before any permanent form of world association is possible. The vital thought and study in these matters are required now if we are to be ready in time, and no pre-occupation with the conduct of the war can justify postponement of the facing of these tasks, more difficult and more arduous than any the leaders of the United Nations have yet encountered. Whether they prove equal to those searching demands, whether they can provide the leadership which will find and secure acceptance of a solution of these difficult problems of world order depends on whether they bring to their task not only the realism and vision on which Mr. Curtis insists, but whether also they have the imagination to take their peoples into their confidence and to make them understand the conditions and the sacrifices involved, so that neither peoples nor leaders shall again be guilty of the moral slackness and indulgence that, as Sir Geoffrey Knox has just pointed out, played so large a part in robbing us of the fruits of victory after the War of 1914–18 was concluded.

Unless both leaders and peoples alike have the courage to face the full facts and the resolution not merely to shape the appropriate instruments but to use them with imagination and discipline, our hopes of a better world order and an enduring peace are vain indeed. For whether that world order comes by evolution or by revolution in the physical world, it may well involve a moral revolution, for it is based on men and women and human values: courage, unselfishness, and magnanimity, firmness of purpose and clarity of vision, truth and honesty—these are the ultimate foundation.

SCIENCE, RELIGION AND EDUCATION

Science, Religion and the Future

A Course of Eight Lectures. By the Rev. Charles E. Raven. Pp. x+126. (Cambridge: At the University Press, 1943.) 7s. 6d. net.

Education in World Ethics and Science

Conway Memorial Lecture delivered at Conway Hall, Red Lion Square, W.C.1, on March 28, 1943. By Sir Richard Gregory. Pp. viii+40. (London: Watts and Co., Ltd., 1943.) Cloth, 2s. net; paper, 1s. net.

Discipline for Democracy

By T. V. Smith. (Weil Lectures on American Citizenship.) Pp. xiv+137. (Chapel Hill, N.C.: University of North Carolina Press; London: Oxford University Press, 1942.) 12s. net.

THE "conflict between religion and science", to quote from the title of J. W. Draper's book published in 1874, which was widely read sixty years ago, means practically for most of us the battle between believers in the Biblical accounts of creation and believers in the theory of evolution. That contest has abated its intensity, but there is evidence that it still exists, though in milder forms, in places much nearer than Tennessee. This is the point of departure chosen by Dr. C. E. Raven, regius professor of divinity in the University of Cambridge, in a vigorously written book which has recently appeared. Insisting on the necessity of outspokenness, he declares that "while the Christian religion as professed by the churches still clings restrictively to a *Weltanschauung* that is demonstrably unscientific, to superstitions that violate the intelligence and to conduct that shocks the morality of modern man, no such consistency as is essential can be expected. To be a Christian, or at least to hold official position in the churches, is to accept formulæ parts of which can only be explained by being explained away, or else to keep secular knowledge and religious belief in permanent estrangement". Dr. Raven gives a characteristically lively account of the conflict which began on June 30, 1860, with the encounter of Huxley and Wilberforce at the Oxford meeting of the British Association, and which "made overt and abiding the cleavage between traditional Christianity and progressive science".

The author's main concern, however, is not with the conflict as a historical fact, but with what he holds to be "its tragic consequences in the bewilderment, corruption and destruction of mankind". For, says he, "the outbreak of the struggle in 1939, though it plainly demonstrated the need and the opportunity for the assertion of an integrating, and, as many recognized, authentically Christian ideal, found the Church theologically and ethically divided and in consequence practically impotent". So it was left to "the bright superficiality of the Brains Trust to supply the public with answers to its problems and guidance in its search for a philosophy of life". The remedy, for which the author puts in a powerful plea, is the unflinching application of the scientific method to every human interest. It is largely, he says, the acceptance of psychology as a science, complementary as this acceptance is to the stress upon the subjective and relative elements in the new physics, that "has led the younger men to claim all organized knowledge as the scientist's proper province, and to consider how methods can be developed for the scientific study of ranges of experience not amenable to the technique appropriate to material objects in a laboratory". The scientific method is not the sole perquisite of workers in laboratories, but may be applied "as rigidly and honestly in their proper fields by historians and even theologians". Needless to say, the author strongly dissents from the position that scientific method necessarily involves measurement. Throughout the book the author obviously tells the reader exactly what he thinks, with a minimum of care for official discretion. He writes not only as a distinguished theologian, but also as an ardent field naturalist.

All things considered, one need not wonder at finding points of contact between Dr. Raven's lectures and Sir Richard Gregory's Conway Memorial Lecture delivered last March. It is perhaps permissible to say that the former writes as a scientific humanist and the latter as a humanistic scientist, and that between the two there is no yawning gulf. Sir Richard, for example, recalls incidentally the story of Joshua's treatment of Jericho, remarking that Hitler is doing the same to-day on a vastly larger scale. "Such, however," he proceeds, "is the reverence attached to Holy Scripture that in a 'Lift up your Hearts' talk with which a B.B.C. clergyman opened the day a short time ago, he told the story as an example of a warrior following a Divine command! This is a kind of religious teaching against which both heart and reason revolt." Sir Richard's general position is that while science cannot deny the fact of religion or the influence of religious faith, it may examine them and seek to understand them. "With increase of knowledge, much of the mystery upon which religious beliefs are based is revealed and new concepts have to be created to satisfy the rational mind. It is when there is a refusal to recognise this essential function of progressive knowledge that conflict arises between religion and science." He reasonably claims that the changes associated with the meaning of modern civilization are results of scientific discovery and mechanical invention, and that progress in these has never been encouraged by religious teaching. He has no quarrel with religious teaching, including Christian teaching, except when it is intolerant, and he regards it as intolerant when it ignores or even denies the virtues of other great religions, adherents of which are at this moment fighting on our side for a certain way of life upon which they place an equal value.

The remaining book of those here selected for notice is also the permanent record of a lecture, one of the Weil Lectures on American Citizenship given at the University of North Carolina. The author, who writes with equal charm and candour, is Prof. T. Vernor Smith, of the University of Chicago. As eternal vigilance is the price of liberty, so, says the author in effect, is strict discipline the price of democracy. He makes very clear what we are fighting for. What a burden is laid upon the spirits of free men, he cries, to have to do evil that good may possibly be restored! "For the whole world to sink as low in spiritual tone as Naziism has sunk would be to lose next to all that civilisation has gained. It would be to lose truth to its boasted subversion, a propaganda diabolically intent upon prostituting goodness and beauty no less than truth to the poison of power." Keeping the three absolute values in view, he proceeds to deal with science as the discipline of truth, art as the discipline of beauty, and (strange as it may sound at first) politics as the discipline of goodness. Such is the discipline to which democracy must strive to submit.

Democracy is unworkable except by "agreement among equally able and equally honest seekers after truth"; and, says the author in a significant passage, the simple fact is that religion has no method of resolving differences and of begetting agreement. For that reason he rejoices at "the wise separation of Church and State" in the United States. Toleration is the only solution of the differences between Methodists and Baptists. For reasons that lie in history, Unitarianism is more important in New England than in Old England, and the author quotes the witty remark that Unitarianism proclaims "the fatherhood of God, the brotherhood of man, and the neighbourhood of Boston". Generalize that saying, and you have the reason why religion can never be a reconciler of differences. Science, not religion, provides "the strategy of agreement". Some citizens (men of science) "indulge" in it and enjoy its roots, more citizens (teachers and the like) "participate in it and smell its sweet flowers", and all citizens are beneficiaries of it and enjoy its fruits. Thus far science, with its disinterested and relentless pursuit of truth. The searchers are few, but the beneficiaries are all mankind.

Yet the author departs from the hard counsel of W. K. Clifford, that it is wrong "always, everywhere, and for every one, to believe anything on insufficient evidence". Truth is not the only value which defines civilization. Civilization would be infinitely poorer if it were so—witness the classical instance of Charles Darwin, who lived to lose all his early interest in poetry, pictures, and music. Science contracts the life of imagination. Art expands it, up to the acceptance of all which the mind's eye can discern. Again we have the citizens (artists) who indulge in art and enjoy its roots, more (parents and teachers and trainers) who participate in it and smell its sweet flowers, and all citizens who are beneficiaries and enjoy the fruits so vividly described by the author.

What of politics, as the discipline of goodness? Reduced to simple terms, politics are just the art or the science of settling disputes. Domination is the only alternative when equally honest men are in deep difference as to what is good. Either one side gets its complete way—which is dictatorship—or a new way is devised in which each gets enough of what it wants to observe a truce in the spirit of sportsmanship—which is democracy. Here the author gives a shining example of political compromise at work. The American Union is a system of two incommensurable but not incompatible principles, the principle of compromise for the settlement of all weighty disputes, and the principle of no compromise for the protection of all private principles compatible with public order—such as religious principles. The author will not allow the finger of scorn to be pointed at the politician, and he shows that all citizens of a democracy enjoy more fruits than they themselves create.

The functions of science, art and ethics in a well-ordered democracy, and incidentally the treatment of religious and other private convictions, are trenchantly discussed in this remarkable book. The author should become better known in Great Britain.

T. RAYMONT.

JOHN GILBERT: ORNITHOLOGIST

Strange New World

The Adventures of John Gilbert and Ludwig Leichhardt. By Alec H. Chisholm. Pp. xxii+382+25 plates. (Sydney and London: Angus and Robertson, Ltd., 1941.) 12*s*. 6*d*.

THIS book tells of two journeys of discovery, the one free of hazard and successful beyond expectation: the other always on the brink of disaster, ending in stark tragedy. The first adventure is that undertaken in 1938 by Alec Chisholm in search of personal relics of John Gilbert, the second is that of Ludwig Leichhardt, who in 1844 set off over the Darling Downs to reach Port Essington. The name of John Gould "the Bird Man" is known all over Australia in association with the wonderful bird fauna of Australasia. John Gould is a substantial figure whose achievements are amply chronicled in the "Dictionary of National Biography" and other works of reference. John Gilbert, though almost equally well known as a name in Australia, was, until Chisholm's voyage of discovery ended in triumph, no more than a name to anyone, for next to nothing was known of the man himself. How Chisholm finally discovered Gilbert's note-books and diaries in the possession of Drs. Geoffrey and Alan Edelsten, grandsons of John Gould's eldest daughter Eliza, is a story of happy achievement. John Gilbert has at least become a real individual whose doings in Australia and even whose intimate thoughts are revealed in his note-books; and if his birthplace, his youth and his life before his association with Gould are probably destined to remain unknown, we are happy that the man, now the curtain has been partly drawn aside, is seen as something bigger than a mere intelligent field collector whose labours made it possible for the wonderful son of a gardener to publish the "Birds of Australia".

But Gilbert's diaries do more than this, for he was foolish enough to become one of the misguided band that placed itself under the leadership of Leichhardt, whose ill-considered overland expedition from "Jimba" (north of Brisbane) to Port Essington (north of Port Darwin) set out in September 1844. During this trying journey, until his death at the hands of the natives on June 28, 1845, John Gilbert, though loyally supporting the leader of the expedition in every possible way, could not refrain from noting, in the intimacy of his diary, the character and the actions of the man who was responsible for the enterprise. These notes made by Gilbert amply confirm those estimates of Leichhardt's character afterwards made by Bunce, Mann and others who were associated with him in his later enterprises. Gilbert's diary throws much light on this unsatisfactory and overrated man, and it is time that the tradition of Leichhardt's greatness be permitted to pass into oblivion.

The real facts concerning Friedrich Wilhelm Ludwig Leichhardt seem to be that, after an obscure boyhood on the farm of his parents in Prussia, he became an unsatisfactory student at Göttingen and Berlin. Infirm of purpose in all things save in a determination to avoid work, he indulged in introspection and became absorbed in overwhelming self-pity. He drifted. It seems certain he never pursued any study to the length of taking a degree. His Australian assumption of the title "Dr." and his claim to be a medical man appear to have been merely indications of vanity, and his treatment of the sick men under his care belies any possibility of a medical training. Unwilling to make any effort to earn his own living, he became parasitic on friends and fixed his tentacles firmly into a worthy English fellow student named William Nicholson. Nicholson brought him to England and later, apparently as the only way of being rid of the incubus, gave him money and paid passage for him to Australia. In his new environment, he again became parasitic on friends and made no effort to find occupation until, financed and equipped at the expense of others, he started on the enterprise for which he had no sort of qualification either of leadership or of attainment. Briefly, he proved disloyal to the men who risked their lives with him, he was callous to the sick men in his charge to the length that he stole their rations when they were no longer able to claim them. He was cruel to animals, on the proper care of which his success so largely depended. Even in a camp of rough men living in rough times and under great disadvantages his personal habits, evinced in his total disregard of hygiene and disgustingly coarse dietetic tastes, proved revolting. These personal characteristics rendered him unfitted to lead; but unfortunately for the men who placed themselves under his leadership, he was devoid of any real knowledge of bush craft and was incapable of taking an accurate observation to determine his whereabouts. On one occasion Gilbert notes that the party had struck a valley which, since they felt sea breezes, they thought would open out into the Gulf of Carpentaria. As a matter of fact, the expedition was not within a thousand miles of the Gulf and the sea breezes came from the east coast near the site of the present town of Rockhampton.

Perhaps a more remarkable circumstance revealed by Gilbert's diary is the fact that within the first four months of the expedition, nine out of the ten members of the party had been hopelessly lost in the bush at some time or other and that the leader had had this unfortunate experience on more than one occasion. To be completely lost in the bush is a terrible experience for any man, but for Leichhardt it was especially dangerous since, as he was unable to use a gun, he was quite incapable of obtaining food. The odd thing is that these experiences never seemed to diminish the man's vanity or to make him any more cautious or responsible; and so Gilbert's story goes on up to the tragic night when he received his fatal spear wound and the diary ceased abruptly.

Even of this incident Leichhardt refrains from telling the truth, which was, however, suspected by Gilbert and told in his diary the day before his death. Leichhardt told the world that the attack of the natives was entirely unprovoked. Gilbert suspected, and Leichhardt knew quite well, that the attack was an act of retaliation by the natives for brutal interference with their women by Brown and Charlie, the aboriginal members of the party.

Here, with the death of Gilbert, we may leave Leichhardt. Had he never undertaken his last ill-conditioned enterprise and with his unfortunate fellows, his circus of horses, mules, cattle, goats, sheep and dogs, vanished completely and for ever, he would probably have been assessed at his true worth and not have become a legendary hero in Australia. As for John Gilbert, all ornithologists are in debt to Chisholm for giving us even a partial picture of a man who, under the worst possible conditions, patiently fulfilled his mission of collecting the

Australian fauna, to the gain of science. Nor was Gilbert a mere collector. It was surely a remarkable thing that, even when short of food, clothing and every other necessity and at the end of a day of hardships, he would sit down and write several thousand words on the habits of birds and beasts observed during the day. To those who have experienced even a minor degree of such conditions it must appear still more remarkable that he wrote all his notes neatly with pen and ink. He had the true spirit of science, and Chisholm is to be thanked for letting us know more about John Gilbert the naturalist as distinct from John Gilbert the man who collected for Gould.

The reviewer has only one regret after reading this valuable addition to our knowledge of birds and men in the early days of Australia. Surely the title—"Strange New World"—is a trivial and even misleading one under which to launch so important a contribution to biography. F. WOOD JONES.

OBITER DICTA OF A SOCIOLOGIST

Diagnosis of Our Time

Wartime Essays of a Sociologist. By Karl Mannheim. (International Library of Sociology and Social Reconstruction.) Pp. xi+179. (London: Kegan Paul and Co., Ltd., 1943.) 10*s.* 6*d.* net.

PROF. MANNHEIM has achieved a position of deserved distinction among sociologists as the author of "Ideology and Utopia". In the present volume he gathers together a number of his addresses delivered to audiences as diverse as the staff members of the University of Durham and the listeners-in of the B.B.C. overseas broadcasts.

In his addresses on education he shows an approach that is in many ways typically Continental and which, in my experience, shows itself whenever the representatives of European universities, secular or Catholic in type, meet representatives of the universities of the English-speaking world. Values are known, Prof. Mannheim feels, and the educator must teach them. In the English-speaking world there is a persistent (and to my mind valuable) prejudice to the effect that truth has to be groped for and that, when 'values are taught' dogmatically, this generally ends by meaning that the schools will teach whatever particular set of values the government and politicians of the day find convenient—whether it be the commandment of the Decalogue "Thou shalt not kill" or conversely the maxim *dulce et decorum est pro patria occidere*. Either way the pure light of disinterested inquiry is smoked.

Prof. Mannheim, however, performs a very valuable service in raising this issue of values, even if his language occasionally seems too guarded and discreet and as if he had the sense of being a guest. Mr. Lewis Mumford and Dr. Archibald MacLeish have raised this issue in the United States and, in a very different but more profound sense, Mr. Herbert Read has done so in Great Britain, as have various theological writers such as Niebuhr and Berdyaev. Prof. Mannheim has my sympathy in endeavouring, unlike the last-named, to state his values in humanistic terms. Like Dr. Peter Drucker he is concerned with what he calls "planning for freedom", and the type of civilization of which he approves, neither National Socialist nor National Communist, fits into this framework. He rightly insists that although we can perhaps teach mathematics, we cannot teach, for example, history, without a sense of social values (which does not mean that it is futile to try to teach history or political science 'objectively'). If this sense is not permitted explicit expression, then, as with the village atheist teaching in the village church school, it finds expression covertly. We have to decide whether we approve of the current worship of 'dynamism' and of what Dr. Mannheim calls "the demoniac image" (by some others called "the heroic image") "of man emphasizing power and the military virtues of discipline", etc. I am frank to say that I myself, holding very strongly views which I imagine are those of Prof. Mannheim, would yet like to see senior schools in which both views—the dynamic-heroic (or demoniac) and the religious-quietist—were taught. I agree with Plato—and I suspect disagree with Prof. Mannheim—in believing that the human race is not monotonous and all cut out of one cloth, but functional—some natural economic Marxists, some natural Fascists or pro-Fascists (such people, for example, as some of our most vocal patriots and contemplatives, bomber-leaders), and some natural or rulers (spiritually or techno-cratically speaking). The real problem of values is to give to each of these attitudes due weight and no more than due weight.

Prof. Mannheim obviously distrusts the Marxist basically economic interpretation of history; is concerned about the excesses of an industrial civilization; touches on that question of neighbour relations now preoccupying the mind of MacMurray, Heard and others under the name of 'community' (incidentally resurrecting the good Prof. Cooley). He assumes, unlike Prof. Laski, "fundamental agreement on the method of experiment" in our democracy. He aspires to develop a philosophy of 'the middle way' between *laisser faire* and totalitarianism. I myself, having sought precisely such a middle way in my "Preface to Action", and found it, as between Germany and the U.S.S.R., as the Anglo-Saxon philosophy of experiment, or what Dr. Fromm calls 'spontaneity', am now inclined to the more pessimistic belief that a rhythm occurs in history between the extremes, and that the only remedy for the extremity of the extreme is to be found in a humanistic scepticism about what can be achieved in the formally political or governmental sphere. What matters are the outlooks of societies rather than the forms of government. What really matters is the conformity of local institutions to the simple human intuitions, and not this plan or that plan as a creed or as more than an empiric instrument to be discarded at convenience. There can be a 'planned freedom' for a steel worker in need of employment and sport; I do not see how there can be a planned freedom, in any profound sense, for an artist of vision. He will have to find his own 'like-minded society'. Freedom, in the last resort, is not a political matter (despite Prof. Mannheim's antithesis of individual and society, meaning society-under-government) but a spiritual matter. However, that what is here called "value standardization" is not only possible in small communities but also can be successful in large is shown by the example of China. I put down this book with the feeling that I should like to see many of its central ideas further developed, and with a desire to be present at a debate between Dr. Mannheim and Dr. Niebuhr. I should be an impartial arbiter.

GEORGE CATLIN.

APPEARANCE OF GLUTATHIONE DURING THE EARLY STAGES OF THE GERMINATION OF SEEDS

By Sir FREDERICK GOWLAND HOPKINS, O.M., F.R.S., and EDWARD JAMES MORGAN

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TWO interesting papers have been published containing studies of the phenomena with which the present research is concerned. Firket and Comhaire[1] state that while absent in the dry pea, glutathione, or at least –SH compounds, rapidly appear after these are placed under water. These sulphydryl compounds are distributed throughout the cotyledons, seeming to prepare the conditions for the growth of the embryo rather than being produced under its influence. After reaching a maximum they diminish during the growth of the embryo, more slowly when growth proceeds in the dark. Vivario and Lecloux[2] confirm the early appearance of glutathione during hydration. It reaches a maximum after 4–6 hr.; this increase is more rapid at 38°. The authors found that formation is quicker in powdered peas owing to the more rapid uptake of water.

The facts revealed by the above authors are of much interest but the numerical data they present require revision. In each case it was, of course, realized that other reducing substances besides thiol groups might be present. They therefore carried out two titrations with iodine, one with nitroprusside as indicator and the other with starch. The latter gave somewhat higher figures than the former, and the difference was assumed to be due to other reducing substances. It is now known, however, that the use of nitroprusside as an indicator gives unreliable results. Moreover, these results were calculated as glutathione when this was still supposed to be a dipeptide. In any event, although with animal tissues it is usually safe to assume that no other thiol compounds need to be considered, this assumption was not justified in the case of germinating seeds, where protein changes are so active. Free cysteine might well be present, and, indeed, we have found this to be the case.

We have ourselves succeeded in isolating glutathione from germinating peas by methods which will be described.

Experimental

The early appearance of –SH groups during germination is clearly general among plants, and appears universal. On qualitative lines we have proved their presence in the seeds of the following: Gramineæ (endosperm): rye, barley, wheat, maize; Leguminosæ (cotyledons): sanfoin, vetch; Cruciferæ (cotyledons): cabbage, mustard, wallflower; Chenopodiaceæ (endosperm): spinach; Caryophyllaceæ (perisperm): silene.

In each case, 5 gm. was extracted with trichloroacetic acid, the extract saturated with ammonium sulphate and centrifuged, and to the solution one drop of 5 per cent nitroprusside and then ammonia were added. This was usually on about the second or third day of germination. A positive reaction was always obtained varying somewhat in intensity, the strongest being in the Leguminosæ and the weakest in the Gramineæ. Kozlowski[3] obtained qualitative reactions for –SH in a variety of seeds. He also found that the Leguminosæ gave the strongest reaction.

Isolation of Glutathione. We found greater difficulty in this task than is offered in the case of yeast and animal tissues. Our first attempts, however, were made on lines that have been customary, but these early experiences may be very briefly described. We worked chiefly with different strains of the garden pea, and we used trichloroacetic acid as an extractive. Such extracts have the fundamental fault that, in them, all metallic precipitants produce precipitates which are apt to be colloidal in character. We tried cadmium acetate but found that this gave so bulky a precipitate that it could have little selective value. We therefore used the familiar mercuric sulphate reagent. Its precipitates tend to be colloidal, but with careful adjustment of pH we found we could centrifuge and wash them, though at each stage with some loss.

In one experiment 3 kgm. of peas, on the fifth day of germination, was ground up in trichloroacetic acid by use of sand in a mechanical pestle and mortar. In the extract, after some preliminary treatment, we used mercuric sulphate as a fractional precipitant, and from the three fractions, after the usual treatment, we obtained three separate products. Of these only one (the most soluble) yielded the typical copper compound of glutathione on adding cuprous oxide to its solution in 0·5 N sulphuric acid. The product obtained from this acted characteristically as a coagent to glyoxalase activity. Moreover, when heated in aqueous solution, it gave, after evaporation on the open water bath, typical crystals of the diketopiperazine of cysteinyl-glycine. The product evidently contained a large proportion of glutathione, but its melting point was low, and it gave analytical data which showed it to be impure. It is noteworthy that the other two of the three products referred to, after oxidation, showed typical hexagonal crystals of cystine.

Trichloroacetic acid is clearly not very satisfactory for the extraction of plant tissues. Moreover, at this time it became difficult for us to work on a large scale. We therefore worked out another process applicable to relatively small quantities of material; this gave satisfactory results. The seeds are first ground up by hand in a mortar with 0·1 N sulphuric acid and a little washed sand, the extract centrifuged and the solution half saturated with solid ammonium sulphate. The filtrate from the precipitate thus produced (350 ml.) is brought to 0·5 N sulphuric acid. To this, cuprous oxide is added in small quantities with frequent stirring. It is remarkable that no precipitate appears at once, but after standing for twenty-four hours a quite typical precipitate of the copper compound separates. It would seem that some unstable association between the cuprous compound and the ammonium sulphate is first formed (? a co-ordination compound) which slowly decomposes. These facts apply no less to pure glutathione.

The only drawback to this simple procedure is that, owing to the delay in the separation, it is difficult to estimate with exactness the amount of cuprous oxide which is necessary. Slight excess is added, and after standing for twenty-four hours in an open beaker, the precipitate, which may be mixed with a small amount of copper oxide, is centrifuged off and the fluid allowed to stand for a further twenty-four hours. If more of the copper compound separates, this is centrifuged off and added to the first precipitate. After forty-eight hours no further precipitate has ever been observed.

Preparations 1 and 1a. 10 gm. of peas was soaked for twenty-four hours in water and then treated as above. The crystalline copper precipitate, after washing free from sulphate, was decomposed as usual, and the filtrate from the sulphide freed from hydrogen sulphide by a stream of hydrogen. One half was evaporated to dryness in a vacuum desiccator and weighed 25·5 mgm. (51·0 mgm. per cent). This residue titrated with 0·01 *N* iodine used 7·3 ml., equal to 22·41 mgm. (44·82 mgm. per cent) of glutathione. A quantitative estimation was made by Woodward's manometric method[4]. For the latter a four-point reference curve was first obtained to establish accurate relations between the tripeptide and the carbon dioxide measured. The glyoxalase was made from rats' red corpuscles on the lines described by Jowett and Quastel[5]. The amount of the solution used for the estimation contained 0·127 mgm. of the preparation, and the amount of carbon dioxide evolved in 20 min. (99·54 μl.) was equivalent to 23·0 mgm. (46·0 mgm. per cent) of glutathione. As in this experiment the whole solution was taken directly to dryness and not crystallized out from a mother liquor, it will be understood that the slight excess in the weight of the residue might be due to a trace of impurity. But it would seem that the product was practically pure.

100 gm. of the peas, after soaking for twenty-four hours in water, was transferred to a funnel (which permits of an adequate oxygen supply) and allowed to germinate for three days. The peas were then treated as above. The total residue of the final product was 14·6 mgm. per cent, by iodine 11·05 mgm. per cent, and by Woodward's method 11·0 mgm. per cent. These results confirm the statements of Firket and Comhaire[1], also those of Vivario and Lecloux[2], that the sulphydryl groups diminish once actual growth is established.

Preparation 2. The preparation obtained in the last experiment, although giving satisfactory evidence for approximate purity, was not crystalline. We therefore decided to work on a larger scale in order to obtain a crystalline product. We still found it convenient to work on small quantities of 100 gm. each, accumulating the copper compound from eleven such extractions. This, washed free from sulphate and decomposed in the usual manner, yielded 0·346 gm. of a crystalline product. This was undoubtedly pure glutathione. On rapid heating it melted sharply at 190°, and the product mixed with pure glutathione also melted at 190°. It gave the following analytical results, the mean of two closely agreeing duplicates: found C, 39·03; H, 5·52; N, 13·68; S, 10·36; glutathione, $C_{10}H_{17}O_6N_3S$, requires C, 39·09; H, 5·54; N, 13·68; S, 10·42.

Kozlowski[3] was the first to attempt the isolation of glutathione from peas. So far back as 1926, working in the Biochemical Laboratory at Cambridge, he spent much labour on the problem, employing as much as 25 kgm. of material for each extraction. He succeeded in proving the presence of non-protein cysteine but obtained no product identical with glutathione. After Hopkins[6] had described the use of cuprous oxide as a precipitant, he returned to the problem[7], but again was not successful in isolating a pure substance.

It will be remembered that Vivario and Lecloux[2] found that the production of –SH groups proceeded in powdered peas when this material was placed under water. We have confirmed and extended this observation.

Thunberg vacuum tubes were employed. Two series of –SH determinations were made. In one the powder had stood under an aqueous buffered solution; in the second it had stood under a similar solution to which the disulphide form of glutathione had been added. The following are the details of our procedure.

5 gm. of the pea powder was weighed into each of a series of large Thunberg tubes. 16 ml. of water and 2 ml. of *M*/5 Sørensen's phosphate buffer *p*H 6·0 were then added to each tube; to one series of tubes, 2 ml. of water, and to the others, 2 ml. of a solution of the disulphide form of glutathione containing 60 mgm. (neutralized to *p*H 6·0) were then added. The tubes were then evacuated, refilled with nitrogen and again evacuated; the procedure being repeated three times. The tubes were allowed to stand, with an occasional shake, at the room temperature of 17°. At intervals the reaction was stopped by sucking in through the side tube 10 ml. of acid (8 per cent trichloroacetic and 2 per cent metaphosphoric acids) as used by Musulin and King[8]. The precipitate was centrifuged off, successively washed with 5 per cent acid and made up to 100 ml. Half was titrated with 0·01 *N* iodine in the presence of potassium iodide, and the other half with Tillman's reagent using the micro method of Birch *et al.*[9] The iodine value of the very small amount of ascorbic acid as determined by the indophenol titration found under the conditions of our experiment at 18 hr. and 24 hr. has been deducted in the following table.

Hours	0·01 *N* iodine per 5 gm. peas (ml.)		Calculated for glutathione (mgm./100 gm. peas)	
	No GSSG*	+ GSSG	No GSSG	+ GSSG
0	1·4	—	85·96	—
4	2·0	6·2	122·80	380·68
12	2·0	7·6	122·80	466·64
18	2·0	8·8	122·80	540·32
24	2·3	9·1	141·12	558·74
24†	1·5	1·5	92·10	92·10

* GSSG = Disulphide form of glutathione.
† Heated for 15 min. at 70°.

To judge from many known cases, the production of sulphydryl groups is likely to depend on the transference of hydrogen from donators to acceptors capable of yielding –SH groups. In the present case these are likely to be the oxidized form of glutathione together with cystine. We do not yet know whether the former is present ready formed in the seed stores, or whether it may be synthesized rapidly when the necessary amino-acids are made available by proteolysis.

Thunberg, in a number of papers, has shown that dehydrogenases of various kinds are present in seeds, but we do not yet know which of these, if any, are concerned with the –SH production.

Our experiments with the powdered material show that the –SH groups are rapidly formed. Referring first to the preparations containing none of the disulphide form of glutathione, it will be seen from the above table that at the fourth hour their concentration has already reached a maximum.

It will be seen from the table that there was a considerable concentration of the –SH groups present in the pea powder we used for the experiment. This experiment was made at a time of the year when natural germination would occur. There is no doubt that when the atmosphere is warm and moist, reactions may begin in the intact pea.

We were led to try the effect of adding the oxidized tripeptide owing to a suspicion that the hydrogen acceptor groups were saturated before the hydrogen supply was exhausted. It will be seen that, in consequence of this addition, a large increase in the titratable –SH groups was found.

In order to convey an idea of the extent of the reactions, we have converted the whole of the iodine values as though due to the reduction of the disulphide form of glutathione. It will be seen that the powder by itself reaches the relatively high figure of more than 140 mgm. per 100 gm., while with the addition of the disulphide form of glutathione it becomes no less than 540 mgm.

There is no doubt that the –SH groups start disappearing as soon as visible growth begins (see preparations 1 and 1*a*). We have made no attempt to ascertain the nature of their fate.

Summary

(1) When dry seeds are exposed to water, their contents come to display a high concentration of thiol groups, which rapidly reach a maximum. Later, when growth proceeds, there is a steady fall in the concentration of these groups.

(2) A method is described which has enabled us to isolate (from peas) pure crystalline glutathione.

(3) We have also worked with peas in the powdered form, and have found the same rapid production of thiol groups. The powder further displays a high reducing power towards the oxidized form of glutathione.

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PRINCIPLES OF THE USE OF NON-REFLECTING FILMS IN OPTICAL INSTRUMENTS*

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WHEN light from an object passes through an optical system to form an image, a small fraction is reflected at each air-glass surface instead of being transmitted. For normal incidence, the reflectivity is usually between 4 and 7 per cent, depending on the refractive index of the glass. This affects the image in three ways. First, the brightness of the image is reduced. Secondly, the reflected light, eventually reaching the image plane after two or more reflexions at the lens surfaces, invades the dark parts of the image and gives rise to a haze called 'veiling glare'. This reduces the contrast in the image. Thirdly, the reflected light may concentrate near the image plane to form 'glare spots' and 'ghost images'.

Optical systems are therefore only able to function at their best when unwanted surface reflexions are reduced to a minimum, and that is the purpose of non-reflecting films. The property of light on which they depend is that of interference, by means of which the distribution of the radiation is altered in such a way that the reflexion is reduced and the transmitted light increased. Nothing is sacrificed in reducing the reflexion.

Interference at a glass surface is brought about by coating it with a thin transparent film. As we are concerned with getting a reduction of reflected light, it is necessary, as will be shown later, that the film shall be of lower refractive index than the glass. Suppose, then, that a pencil of monochromatic light from a distant point source falls on a glass surface which has been coated with such a film (see diagram).

Consider the composition of the reflected ray *R*. As will be seen from the diagram, it consists of the reflected portion of the ray *A*, augmented by contributions from other rays such as *B* and *C* which emerge at *A′* in the direction *A′R* after multiple reflexions within the film. Similarly, the reflected fraction of the multiple reflexions arriving at *A′* is added to the directly transmitted ray *AT*. The directly transmitted components of *B*, *C*, etc., and their reflexions at the first surface each become part of separate interference systems identical with the one being considered, so that whatever happens to the rays *R* and *T* applies equally to similar rays from any other point on the film.

The calculation of the intensity of the transmitted and reflected beams is tedious and is to be found in the text-books. As an introduction, however, a simplified calculation of the thickness and refractive index of a film giving no reflexion can be made by taking into account only the incident rays *A* and *B*. This is permissible because although a large number of incident rays contribute to the reflexion *R*, the amplitude of their contributions is very much attenuated by the multiple reflexions which they undergo before reaching *A′*.

The composite reflected ray *R* will have zero intensity when the components from *A* and *B* are in opposite phase and equal in amplitude. For the first condition, the optical path difference must be an odd number of half wave-lengths. For a film of thickness t and refractive index μ, the path difference is $2\mu t \cos r$, where r is the angle of refraction at the air-film boundary.

Therefore for minimum reflexion of light of wave-length λ

$$2\mu t \cos r = (2n+1)\,\frac{\lambda}{2},$$

n being an integer, whence

$$\mu t = (2n+1)\,.\,\frac{\lambda}{4}\,.\,\frac{1}{\cos r} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The condition of equality of amplitudes is met by equating the Fresnel formulæ (which hold for normal incidence and are almost correct for angles of incidence up to 20°) for the amplitudes of the rays reflected at the air-film and film-glass surfaces (refractive index of the glass, μ_g).

$$\frac{\mu - 1}{\mu + 1} = \frac{\mu_g - \mu}{\mu_g + \mu},$$

which gives

$$\mu = \sqrt{\mu_g} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

It is not possible to calculate the exact effect on the transmitted beam of a film defined by equations (1) and (2) without taking into account all the multiple reflexions. It is clear, however, that with

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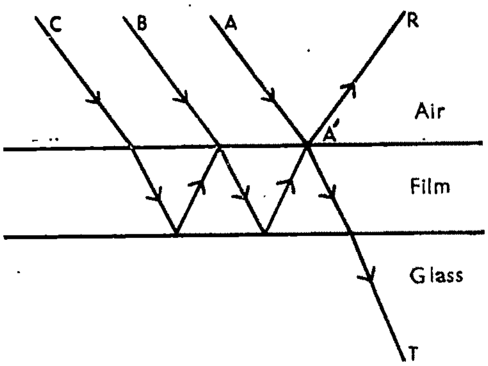
* Substance of a lecture delivered before the Optical Group of the Physical Society on May 15, 1942.



such a film the fraction of the ray B which after internal reflexions is eventually superimposed on the ray AT must be phase with it, because in addition to the half-wave phase change introduced by the thickness of the film, the two reflexions of the ray from B are of different kinds, one being on the less dense side and the other on the more dense side of the reflecting boundary, which increases the equivalent path difference to one wave-length. The criteria for zero reflectance therefore also provide for increased transmission.

When all the multiple reflexions are taken into account the fraction of the incident intensity reflected from a film of which the refractive index obeys the condition of equation (2) is, for small angles of incidence,

$$\frac{4R\cos^2\frac{1}{2}\delta}{1+2R\cos\delta+R^2}, \quad . \quad . \quad . \quad (3)$$

where R is the reflectivity of the film material under the particular conditions of illumination and δ is $\frac{2\pi}{\lambda}\,2\mu t\cos r$.

The fraction transmitted is

$$\frac{(1-R)^2}{1+2R\cos\delta+R^2} \quad . \quad . \quad . \quad (4)$$

Now according to (3), the reflexion is zero when $\delta=(2n+1)\pi$. Putting δ in terms of path difference as given above, we obtain the optical thickness for zero reflectivity :

$$\mu t = (2n+1)\cdot\frac{\lambda}{4}\cdot\frac{1}{\cos r}.$$

This is the same result as that given by the simplified calculation, because the energy subtracted from the B contribution by internal reflexion at A', which was disregarded, is made up by the contributions through multiple reflexion from all the other incident rays.

When the condition $\delta=(2n+1)\pi$ is applied to the expression (4), we arrive at the interesting result that the transmitted fraction is unity, so that *all* the incident light is transmitted when the reflexion is annulled.

It is most important to realize that the rays do not in fact have to be reflected out into the air before they can annul each other. This is not the kind of interference system where the reflected rays have to be combined by a lens. The interference takes place at the interfaces, and the vectors at a point such as A' are such that there is no resultant intensity in the direction $A'R$. There seems to be a certain reluctance to accept the fact that a non-reflecting film can theoretically increase transmission to 100 per cent. I believe that this is largely due to attempts to explain the phenomenon without taking into account the multiple reflexions.

A film defined in refractive index and thickness by the equations (2) and (3) may be termed the 'ideal' film. Let us now discover, first, how the ideal film behaves under practical conditions of illumination and, secondly, how near an approach to the ideal film can be made with available materials and methods.

The angle of incidence enters into the expression for the transmitted or reflected intensities as a cosine function. This means that if a film is non-reflecting for normal incidence, it will be practically so for angles of incidence up to at least 20°. Within this limit such a film is therefore effective with a broad source, in convergent or divergent beams and on curved surfaces.

By adjusting the thickness of an 'ideal' film, extinction of reflexion could be obtained for any chosen angle of incidence up to about 45°. Above that angle, the condition (2) for the refractive index of the film no longer provides a correct balance of the intensities of reflexion at the two film boundaries. Curves showing the variation of reflectivity with these various factors have been published by Blodgett[1] in a very useful article on the properties of non-reflecting films.

Suppose a film thickness is chosen which gives zero reflexion for a monochromatic green light. If the colour of the light is then changed towards either the violet or the red, some will be reflected, the intensity of reflexion increasing as the wave-length moves away from the green until a maximum is reached. The reflectivity then decreases again as the wave-length approaches that which gives the next higher or lower order of interference. (The wave-lengths for zero reflexion due to successive orders of interference are obtained from equation (1) by putting $n=0, 1, 2, \ldots$). If, then, white light is incident on a film which is non-reflective for a monochromatic green, there will still be no reflexion and maximum transmission of a wave-length in the green, but there will be a number of other maxima and minima within the spectral range, depending on the thickness of the film. If the film is thick compared with the wave-length of the light, there will be so many that the resulting reflexion will also be white, but with an intensity half that of the reflexion from unfilmed glass.

Now it so happens that if the optical thickness of the film is only *one* quarter wave-length of green light (for example, $\lambda=5500$ A.), the nearest maxima are so far away ($\lambda=\infty$ and $\lambda=2750$ A.) that the reflectivity for the red and violet is not more than 1 per cent. The filmed surface then reflects a faint purple colour. (When viewed by eye, the increase of reflectivity towards the ends of the spectrum is offset by the decrease in sensitivity of the eye.) The transmitted light is correspondingly increased but the slight excess of green light does not give perceptible colouring when only one or two surfaces are involved. The 'first order' minimum ($n=0$) is therefore chosen for minimum reflexion over the broadest possible range of wave-lengths. The colour region of maximum transmission and minimum reflexion can, of course, be selected at will by choosing the appropriate film thickness.

Estimation of the thickness of a non-reflecting film is a very simple matter because the colour of the reflexion of white light is a sufficiently accurate measure. All the commonly used methods make the films by building up the thickness progressively, so that as the film thickens the wave-length of first-order interference moves up through the ultra-violet and the violet. The reflected light therefore first diminishes in brilliance and turns yellow. As the wave-length of zero reflexion moves through the visible spectrum, the reflected light becomes orange, magenta, purple, blue, green and, when the minimum is in the near infra-red, greenish-white. The succession of colours is repeated with variations in intensity for successive orders of interference. The most useful colour, purple, denoting maximum transmission in the yellow-green, is a very sensitive indicator.

The refractive index of the film should be the square root of that of the glass. The effect of departing slightly from this condition is not serious: visually it results in a 'whitening' of the coloured reflexion because there will be a small residual reflexion at the wave-length of minimum reflectivity. (A 'purple' film of refractive index 1·35 on plate-glass would have a reflectivity in the yellow-green of about 0·6 per cent.) No attempt is made in practice to match the refractive index of films to every type of glass. Instead, a material is chosen which is reasonably well suited optically to a range of refractive indexes and has at the same time good mechanical properties. Silica, sodium aluminium fluoride (cryolite), and magnesium fluoride are commonly used.

A silica film has the great advantage that it is made of the substance of the glass itself, so that it is inherently a durable film. The film is formed by dissolving away the other constituents of the glass in such a way that the silica skeleton remains undisturbed and the polish of the surface is preserved. With glasses such as dense barium crowns and dense flints, the film can be formed naturally by the weathering action of the atmosphere. This 'tarnish' was first reproduced artificially by H. D. Taylor[2] in 1892, and the details of the chemical method are now well established[3]. Owing to the high refractive index of the silica film, even in its skeletonized state, it is only really effective on very dense glasses. Lately Nicoll[4] has described a new chemical method in which hydrofluoric acid vapour is the dissolving agent; good results are claimed with glasses of medium refractive index.

The fluoride films are deposited by the high-vacuum volatilization process[5], the technique being very similar to that used for making metal-on-glass mirrors. The powdered fluoride is evaporated by heating it electrically in a vacuum; it condenses in a vitreous film on any relatively cool surface directly exposed to the source. The surfaces to be coated are so placed that the condensed film is perfectly uniform in thickness. The vacuum is maintained by a fast mercury or oil diffusion pump at a pressure of not more than 10^{-4} mm. of mercury; by using very efficient pumps and taking great care to prevent leaks and evolution of gas in the vacuum chamber, the number of gas molecules can be reduced to as few as one million million per c.c.

The volatilization method generally gives a film of greater optical efficiency than does the chemical method. Magnesium fluoride forms very hard films and is a good match for the denser glasses, while cryolite is a good compromise for the whole range of optical glasses and can be made quite hard enough to withstand unavoidable handling.

In practice, it is found that a reflectivity in white light of not more than 1½ per cent may be expected and that a smaller loss than that is often achieved. Some striking results in the reduction of glare have been reported[6]. Published results for which the conditions of measurement are not given should be accepted with caution. The measurements are sometimes made with monochromatic light, which may give a more favourable result than those made with white light. It even happens that the results are not obtained by measurement but merely calculated on the basis of a reflectivity of, say, 0·4 per cent per surface, and without taking into account the absorption of the glass.

It is hoped that this survey has shown that the optical principles of non-reflecting films permit them to be used under everyday conditions. They are not merely scientific curiosities but are capable of bringing about a very real improvement in the performance of optical instruments.

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PERMEABILITY AND MOLECULAR CONSTITUTION AS FACTORS IN DRUG ACTION

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ONE of the chief difficulties in the interpretation of the analogies between the biological activity of a drug and its behaviour in synthetic systems arises from the ambiguity of toxicological data, which may generally be correlated with solubility in the cell lipoids (Overton-Meyer), adsorption at cell interfaces (Traube), or with other physico-chemical factors. Moreover, these analogies may not hold when other biological systems and homologous series of drugs are compared. Recent work on molecular interaction in monolayers has provided a very valuable guide to the factors which influence specific drug reactivity in pharmacological systems[1]. The principles which have been advanced have greatly extended the implications of the original conceptions of Overton-Meyer and Traube.

In the present article, an attempt is made to correlate existing pharmacological data and theories of drug action with experimental evidence which has resulted largely from a study of the mode of action of insecticides. This work, which was commenced some years ago in Prof. J. W. Munro's Department of Zoology and Applied Entomology at the Imperial College of Science and Technology, London, is at present being extended in the Department of Colloid Science, Cambridge.

Insects comprise a very wide range of biological systems which show a similarly wide range in susceptibility to different drugs. For example, mature blowfly larvæ (*Phormia terrænovæ*) are resistant to high concentrations of drugs applied externally. The iso-active concentrations of alcohols and fatty acids which produce rapid paralysis or narcosis when injected internally into the hæmolymph are relatively inactive over prolonged periods when applied externally, showing that cuticle permeability may be a limiting factor in drug reactivity.

If a comparison is made between the relative external and internal biological activities of members of the homologous series of normal primary alcohols and fatty acids, a wide divergence is shown between corresponding homologues in both series. When Phormia larvæ are immersed in pure drugs, the rate of penetration of alcohols through the cuticle increases as the series is ascended from C_1 to C_5, when maximum biological activity is shown; from C_5 to C_8 there is a progressive decrease in biological activity. Under similar conditions of drug application, the rate of penetration of fatty acids decreases as the series is ascended from C_1 to C_5; from C_5 to C_7 there is a progressive increase in the rate of drug access (C_8 in the fatty acid series is solid at normal room temperatures, and is not suitable for comparison with the liquid drug members).

These results show clearly that drug access cannot be correlated directly with distribution in a heterogeneous system of immiscible phases comprising the external drug phase and the various biophases of the test insect. In homologous series, physical properties such as differential oil/water solubility, capillary activity, viscosity, or vapour pressure change uniformly in the *same directions* as drug chain-length increases. Neither can the divergence between the rates of drug access of corresponding homologues in both series be attributed to differences in concentration gradient across the bulk cuticle framework. The total decrease in molar concentration of pure drug is roughly fourfold as each series is ascended from C_1 to C_8; the absolute molar concentrations of corresponding members of both series are approximately equal.

Still further complications arise when a comparison is made between the relative threshold iso-active molar drug concentrations which produce paralysis when injected into the hæmolymph. The molecular activity of the alcohols increases as the series is ascended from C_1 to C_5, and the relation between biological activity and chain-length approximates to a typical exponential form which is characteristic of toxicological data expressing equilibria between drugs and biological systems. In the fatty acid series, the *iso-active molar drug concentrations remain relatively constant* as the series is ascended from C_1 to C_8. The molecular activity of formic acid is roughly 70–80 times that of methyl alcohol. In both series the intensity of paralysis or narcosis diminishes when the chain length exceeds C_5.

If the comparison between external and internal molecular drug activity is extended to the related series of blowfly larvæ (*a*) *Calliphora erythrocephala*, (*b*) *Phormia terrænovæ*, (*c*) *Sarcophaga falculata*, it is found that relative resistance to drugs applied externally increases in the order (*a*) → (*b*) → (*c*). When the drugs are applied internally by injection, iso-activity is shown by threshold narcotic drug concentrations in all three species of test insect.

This experimental evidence leads to the important conclusion that where diffusion through an intermediary biophase which links the site of drug application with the site of drug interaction is a limiting factor in drug access, relative biological activity measured at the site of drug application may differ from relative activity at the site of action. Drug reactivity may increase, decrease, or remain relatively constant as a homologous series is ascended, according to the mode and site of application.

If we attempt to elucidate the mechanism of drug access through the insect cuticle, it is first necessary to define clearly the nature of the drug interaction with the cuticle framework, which consists of a heterogeneous system of protein, lipoid, chitin, and other components[2]. The nature and relative distribution of these components vary considerably in different insects, but the fundamental cuticle *pattern* may be illustrated by some experiments which have been carried out on the cuticle of blowfly larvæ (for example, *Calliphora erythrocephala*).

Proteins and lipoid substances may be removed from the surface of the blowfly cuticle by the solvent or dispersant actions of water and fat solvents respectively, suggesting that the surface of the cuticle is not homogeneous but composite, consisting of heterogeneous protein and lipoid associations or patches. Similar tests with discrete layers of isolated cuticle indicate that there is a *continuity* of lipoid and protein components throughout the bulk cuticle framework. From this evidence, we may conclude that *functionally* the insect cuticle is analogous to a heterogeneous mosaic system comprising a protein phase associated with a hydrophobic lipoid phase.

An indication of the physical nature of the lipoid components of the cuticle is provided by a comparison of the 'carrier action' of different fat solvents. The primary association of fat solvents with the cuticle framework is physical, and the changes in permeability which are induced are readily reversible. For example, Calliphora larvæ, which are very resistant to pure ethyl alcohol, swell rapidly in ethyl alcohol-kerosene mixtures owing to induced penetration of alcohol by the functional participation of kerosene in the cuticle framework[3]. Penetration of alcohol ceases, however, when the insects are transferred to pure alcohol owing to 'wash-out' of the kerosene from the cuticle framework. After prolonged preliminary immersion in fat solvents, an irreversible increase in cuticle permeability takes place. This is shown by the rapid penetration of pure drugs such as methyl or ethyl alcohol. The rate of drug access is still further increased by fat solvents, showing that only a proportion of the lipoid components is dispersed or removed from the cuticle by fat solvent action. These experiments show that drug access cannot be explained by differential solubility in the lipoids of the cuticle, for if this were a limiting factor, removal of lipoid would tend to diminish drug access.

The physical nature of the oil carrier has a marked influence on the degree of induced drug penetration. Increase in carrier viscosity results in a corresponding decrease in drug access. If it is assumed that the oil carrier acts as a kind of 'diluent' in the lipoid centres, resulting in an increase in free volume of this phase, the variation in drug access with carrier viscosity may be explained by postulating a lipoid phase which is normally of high 'functional viscosity'. The term 'functional viscosity' is not strictly comparable with Newtonian viscosity in a homogeneous liquid, since the protein and lipoid components of the insect cuticle are heterogeneous visco-elastic systems comprising chemically linked networks enclosing the more mobile or labile components which may be removed by solvent action. 'Functional viscosity' gives a measure of the 'yield value' of the lipoid phase to drug diffusion pressure.

From these considerations, the increase in cuticle permeability which is produced by the association of fat solvents with the cuticle framework may be attributed to:

(*a*) A van der Waals' interaction between the fat solvent molecules and the lipoid centres, involving a reduction in mutual cohesion between the lipophilic elements or chains, and resulting in the production of a relatively open three-dimensional chemically linked network enclosing the more labile or liquid lipoid components in which the fat solvent molecules are present. In this way the fat solvent increases the free volume of the bulk lipoid phase, and may also act as a 'bridging' medium which links discrete lipophilic patches in the bulk cuticle phase. Since both protein and lipoid components are enclosed in an elastic lattice framework, alterations in the lipoid phase probably induce associated changes in molecular orientation in the protein phase. Fat solvent 'carrier activity' decreases with increase in viscosity, suggesting that the bulk lipoid phase is normally of high 'functional viscosity'. The main site of 'carrier activity' is in the outer epicuticle layer where lipoid components predominate.

(*b*) A secondary irreversible increase in the flexibility of the lipophilic lattice elements owing to rupture of the van der Waals' bonds which normally influence the stability and elasticity of the lipophilic chains. The elastic restoring forces of the lattice framework oppose the dispersive or disruptive action of the fat solvent. The irreversible increase in permeability is due to the removal of the labile 'bonding' components by fat solvent action, and also to a decrease in 'functional viscosity' of the bulk phase resulting from dispersive action of the fat solvent.

Additional evidence which supports the conclusion that the labile cuticle components act as a 'bonding' phase which regulates the cohesion of the chemically linked cuticle lattice elements is provided by the mode of action of insecticidal powders or dusts. Finely divided 'inert' powders such as quartz or charcoal readily adsorb the relatively labile lipoid or lipo-protein components from the surface of the epicuticle. This process is non-specific, and depends on the adsorptive and storage capacities of the powder, and also on the capacity for lipoid transmission at the epicuticle/powder interface. When the rate of removal of lipoid by adsorption displacement exceeds its rate of replenishment by transmission through the bulk cuticle phase, irreversible secondary changes are produced in the epicuticle framework. Depletion of the labile 'bonding' phase results in a reduction in lateral cohesion of the lattice elements owing to rupture or dispersion of cross-linkages. Once this stage is reached, the insect is unable to control the rate of transmission of water through the cuticle even when the external powder phase is removed, and rapid water loss soon results in death from desiccation. In the normal insect, variation in the rate of secretion of the 'bonding' phase by the epidermal cells may result in corresponding changes in free volume and 'functional viscosity' of the lipophilic centres in the epicuticle framework, thus providing a very sensitive regulatory mechanism for the control of water loss. Analogous effects, which have been obtained in synthetic systems, have provided a very useful basis for predicting the toxicity of insecticidal dusts.

Extending the above concepts of carrier action, we see that a drug may either induce its own penetration, or exert a carrier action similar to that of a fat solvent, provided that the dispersive van der Waals' interaction with the lipoid components is sufficiently strong. For example, access of ethyl alcohol may be induced by octyl alcohol. In the homologous series of alcohols, 'carrier activity' increases to a maximum and then decreases as the series is ascended and capillary activity becomes pronounced. In fact, strongly capillary active alcohols such as cetyl alcohol exert 'negative carrier activity', or antagonism, on the rate of access of a lower homologue such as amyl alcohol. In the fatty acid series, 'carrier activity' becomes pronounced at a later stage (C_6–C_7) than in the alcohol series (C_4–C_5).

This change in 'carrier activity' with capillary activity has a very direct bearing on the mechanism of drug access, for it suggests that a two-dimensional diffusion takes place along the internal lipoid/protein interfaces of the bulk cuticle framework. Within the range C_1–C_8 the adhesion between the hydrocarbon chains of the drug molecules in the series of alcohols and fatty acids is small, and the adsorbed molecules form mobile 'gaseous' surface films[4]. Drug access will depend on (*a*) the association of the polar portions of the drug molecules with the aqueous protein phase, (*b*) the van der Waals' association between the hydrocarbon chains of the drug molecules and the lipoid phase, and (*c*) the interfacial viscosity at the Gibbs' layer.

Two-dimensional drug diffusion along the Gibbs' layer does not preclude three-dimensional diffusion through the bulk lipoid and protein phases of the cuticle, but with this definition of the drug-cuticle phase distribution relations it becomes possible to co-ordinate the gross divergence in drug access between alcohols and fatty acids which was recorded earlier in the present article.

Weak polar interaction of alcohols with the proteins of the cuticle is insufficient to induce penetration through the protein phase. Similarly, the weak van der Waals' interaction of the lower members (C_1–C_3) with the lipoids results in feeble 'carrier activity' within this range. As the series is ascended from C_1 to C_5, the increase in 'carrier activity' owing to dispersive action of the alcohols on the lipoids results in a progressive increase in cuticle permeability. A specificity factor appears to be involved in the non-polar association of the drug molecules with the lipoids of the cuticle, for dispersive action decreases as the series is ascended further from C_5 to C_8, in which range drug access also decreases. The ambiguity between the 'rival' theories of drug reactivity which were mentioned at the beginning of this article, disappears when we consider the physico-chemical factors which influence penetration of amyl alcohol through the cuticle. The intermediary stages in drug access involve the following steps. (i) Differential solubility in the cuticle lipoids resulting in a decrease in 'functional viscosity' of this phase; this agrees with the Overton-Meyer theory of lipoid solubility. (ii) Adsorption at the lipoid/protein interfaces or Gibbs' layer in the cuticle framework mosaic; this is in accordance with the Traube concept of drug adsorption at interfaces. (iii) Molecular interaction with the functional cuticle components at the Gibbs' layer; owing to weak polar interaction with the protein components, there will be little tendency for the drug molecules to become 'anchored' at the Gibbs' layer, and the mobility of amyl alcohol will now depend on the interfacial viscosity. The antagonistic action of carriers of high capillary activity (for example, cetyl alcohol, oleyl alcohol, cholesterol, or oleic acid) on access of drugs of lower capillary activity may be attributed to selective blocking of the Gibbs' layer by the carrier components of the drug mixture. The penetration of lower alcohols (for example, ethyl alcohol) is induced by carriers of moderate capillary activity (for example, octyl alcohol) because the increase in drug mobility owing to dispersive carrier activity is a more important factor than the opposing influence of selective carrier adsorption at the Gibbs' layer. The rapid drug penetration which is induced by non-polar solvents such as kerosene may be attributed to pronounced carrier activity and negligible carrier adsorption at the Gibbs' layer.

The strong polar interaction of fatty acids with the protein components of the cuticle is sufficient to induce selective penetration through the protein phase[5]. Phormia larvæ, which will survive for at least two hours in methyl alcohol, are killed within three or four minutes when immersed in formic acid. We can visualize a kind of competition between the lipoid and protein components of the cuticle for the fatty acid drug molecules. Where chain-length is short (for example, formic acid) polar group interaction will be a limiting factor in drug access. The penetration and expansion of synthetic monomolecular amine and protein films by carboxylic acids suggest that the penetration of a fatty acid through a three-dimensional protein gel involves a preliminary rupture or dispersion of salt interlinkage systems (for example, $-\overset{-}{\mathrm{COO}}\ \overset{+}{\mathrm{NH}}_3-$) owing to competition from the polar groups of the drug molecules. As capillary activity increases, the drug molecules will tend to become anchored at the external layer of the cuticle owing to a balance between the polar and non-polar interaction of the drug molecules with the lipo-protein associations at the Gibbs' layer. The stability of the lipo-protein-drug association reaches a maximum at C_5, when drug access is at a minimum. From C_5 to C_7 this stability decreases as the influence of non-polar interaction begins to predominate over the competing influence of polar interaction. Dispersion of the lipoid phase now becomes a limiting factor in drug access, and this carrier activity accounts for the increase in drug reactivity within this range.

The relative internal drug reactivities may be explained from similar considerations. Within the range C_1–C_5, the logarithmic increase in molecular activity of the alcohols may be attributed mainly to non-polar interaction of the drug molecules with the lipoid loci at the site of action; the relative influence of head group interaction of the 'inert' drug molecules with the protein receptors is negligible. This explains the fact that the relative molecular activities of the alcohols form a typical Traube series. The iso-activity of the fatty acid molecules within the range C_1–C_5 suggests that drug reactivity is influenced mainly by polar interaction with the protein receptors. A factor of non-polar specificity is suggested by the iso-activity of alcohols and fatty acids at a chain-length of C_5; in both series the intensity of narcosis decreases with further increases in chain-length. It is of interest that where the drugs are present as an external phase, a similar factor of non-polar specificity results in a maximum divergence between the relative rates of drug access of corresponding homologues in both series.

The principles which have been proposed in the present article have been based on a very restricted range of pharmacological systems. The fundamental components of a pharmacological system may be resolved into (i) the biological system; (ii) the drug; (iii) the carrier. The ambiguity of existing theories of drug interaction disappears when the relationships of *all* the components in the system are taken into consideration. Failure to recognize the fact that each constituent of a drug mixture may contribute towards gross toxicity imposes a severe restriction on the general application of 'standard' methods of drug bio-assay, especially in connexion with methods which have been proposed for the biological evaluation of insecticides[6]. The general tendency has been directed towards arbitrary elimination of the disturbing influence of unknown variable factors, and 'evaluation' of an insecticidal mixture has been based on the assumption that the main function of a carrier medium is to bring the drug into contact with the biological system, after which drug concentration provides the limiting factor which determines biological activity. The only 'official' test which is at present in use for the evaluation of contact liquid insecticides is the Peet-Grady method[7], in which houseflies are liberated into a specially designed cubical spray chamber and then sprayed with a standard 'dosage' of reference insecticide; comparison is then made with the results of a similar test using an insecticidal mixture of unknown composition. It has generally been assumed also that 'mist action' of the finely atomized spray is mainly responsible for 'knock-down' action. The flaws in these assumptions are shown, by the fact that, under similar conditions of application, a given concentration of contact insecticide (for example, 0·1 per cent pyrethrins) in kerosene produces a rapid 'knock-down' action; a similar concentration of pyrethrins in a heavier oil of the medicinal paraffin type produces a negligible 'knock-down' action, and cannot be 'evaluated', although the mist action is superior to that produced by the lighter oil. This is due to the rapid penetration of pyrethrins which is induced by the kerosene; despite a pronounced mist action, the shortness of the mean life of the atomized heavier oil droplets precludes 'knock-down' action, since carrier activity is relatively slight in comparison with the kerosene spray.

If we extend the principles which have been here elucidated, we see that drug access in an extremely wide range of biological systems may be explained on the assumption that these systems are of the same fundamental *pattern* as insect cuticle. In other words, a visco-elastic lipo-protein mosaic appears to be a common factor in the organization of living biological systems. For example, physico-chemical factors which influence drug access through insect cuticle also apply to drug access through other arthropod integuments, the cuticles of nematode parasites, and various vertebrate pulmonary, muscle, and nerve tissue lining membranes. The analogy may be extended to microscopic systems such as red cells, where the surface is said to consist of a molecular lipo-protein mosaic[8]. Reversible disk-sphere transformations may be produced by primary interaction of fat solvents with the ultra-structure of the red cell. Prolonged interaction disrupts or disperses the lipo-protein associations and results in hæmolysis. The chain of analogies also bridges the gap between animal and plant systems. There is a parallelism between the outer 'cutinized' layer of plant epidermal tissues and insect epicuticle.

If we now consider the drug components, we see that the range of drugs which shows the effects of induced penetration by fat solvents includes feebly dissociating alcohols, ketones, fatty acids, amines, and phenols. The drugs penetrate as unionized molecules. This is in agreement with their greater activity in carriers of low dielectric constant, and also with maximum adsorption at the Gibbs' layer.

The carriers which facilitate drug access include a wide range of aliphatic and aromatic fat solvents. Generally, carrier activity decreases with increase in capillary activity.

Finally, this review of the fundamental analogies between different pharmacological systems may be concluded by stressing the fact that the analogies between liquid drug systems also apply to drugs and drug mixtures in the vapour phase. For example, a mixture of fumigants may be more toxic to insects than the separate components. This may be attributed to the condensation and functional association of the drug components with the cuticle framework.

A full account of the above work will be given elsewhere.

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NEWS and VIEWS

Anglo-American Unity and World Peace

ANGLO-AMERICAN unity was the theme of the address delivered by Mr. Churchill when he received the honorary degree of doctor of laws at Harvard University on September 6. American participation in international affairs, Mr. Churchill said, is not only necessary but also inevitable. Twice in a generation the American people have been drawn into a major war, and a new world order is impracticable without their active participation; the "price of greatness is responsibility". Collaboration among the United Nations has now brought us to a point where there can be no pause. "It must be world anarchy or world order." A potent factor in promoting the joint action of Great Britain and the United States has been the Combined Chiefs of Staff Committee, working immediately under President Roosevelt and Mr. Churchill. This body has reached the stage when it ignores distinctions between things American and British, and disposes of troops, equipment, transport and munitions as if they were the resources of a single nation. This powerful and smoothly running system should not be broken up until we are assured of a practicable form of world security. Looking specifically to the future, Mr. Churchill remarked that various schemes for achieving world security while safeguarding national rights and traditions are being studied. Good work was done in this direction by those who devised the League of Nations, which became ineffective because it was abandoned and its best friends infected with pacifism. "We have learned from hard experience that stronger, more efficient, more rigorous world institutions must be created to preserve peace and to forestall the causes of future wars."

The possession by Great Britain and the United States of a common tongue is, Mr. Churchill said, a priceless inheritance which has smoothed the way to collaboration and "may well some day become the foundation of a common citizenship". Indeed, Mr. Churchill looks beyond that to spreading the English language even more widely throughout the world, and he mentioned that he had persuaded the British Cabinet to set up a Committee of Ministers to study and report upon Basic English. No doubt this committee will take account of the discussions on the use of an auxiliary world language being conducted by the British Association Committee on Post-War University Education and by the Association of University Professors and Lecturers of Allied Countries in Great Britain (see NATURE, December 19, 1942, p. 716 and August 21, 1943, p. 221). Harvard, Mr. Churchill said, has done more than any other American university to promote the use of Basic English, through its Commission on English Language Studies, which has introduced the use of Basic English in Latin America, and is working with certain secondary schools on its use in teaching English to American children and to foreigners preparing for American citizenship. With characteristic understatement, Mr. Churchill remarked, "it would certainly be a grand convenience for us all to be able to move freely about the world . . . and to be able to find everywhere a medium, albeit primitive, of intercourse and understanding".

Barricade Against Spread of Rinderpest in Africa

LATE in 1939, there was news of rinderpest in the south of Tanganyika Territory. Brought originally from Asia, the virus of the disease found a new home in the game and cattle countries in the interior of East Africa. Here those animals which recovered from the first attacks had gained some immunity, thereafter acting as reservoirs of the virus. Then during the War of 1914–18 German manœuvres had carried infected oxen right down to Lake Rukwa in southern Tanganyika, and it seemed that this area might now become the source of further spread towards the south. Consultation between all the Governments of East, Central and South Africa achieved certain conclusions, foremost among them being that at all costs the disease must be stopped from crossing the border between Tanganyika Territory and Northern Rhodesia. Mass inoculations created a safe zone in which the rinderpest virus could not maintain a hold among the cattle. There remained the wild game. The problem was to break the contact between the game in Tanganyika Territory and that in Northern Rhodesia and Nyasaland to the east. Nyasaland is well protected naturally by closely settled belts of native population and a broad river running between high hills; but there is little on the Northern Rhodesia border to check the passage of game. It was decided, therefore, to build a fence along the danger line, from the south end of Lake Tanganyika to the Nyasaland border, a distance of more than 160 miles. The fence was started in August 1940. A stockade seven to ten foot high was made of timber near to hand; only through timberless open plains could the very limited supply of wire be used, fifteen miles in all. The whole fence was finished within a year from the start.

Constant vigilance is necessary to keep the fence in daily repair. Elephant on their customary journeys have smashed through the structure time and again; but fortunately elephant do not carry rinderpest. A human cordon ran the length of the fence: pickets of native African guards, patrolling and linking up each day so that nothing could get through without detection; all under two white officers' supervision. At the eastern end of the fence Nyasaland linked up and carried the human cordon down to the shores of Lake Nyasa, thus completing the great barrier between the two lakes. The game in the fence zone is gradually being pushed back on either side, and in time the danger of contact between north and south should pass away. But the fence itself has proved so valuable in controlling the position that attempts are now being made to prolong its life indefinitely by trenching (the best security against wild pigs) and planting thorns and sharp-spiked sisals which will discourage any buffalo or soft-skinned game from approaching even if they do escape the vigilance of the hunters.

New Synthetic Rubber

A NEW specialty rubber known as 'Paracon' has been developed by the Bell Laboratories, which looks and feels like ordinary rubber and resembles it fairly closely in mechanical properties (*Bell Lab. Rec.*, 20, No. 9; May 1943). It has a high resistance to damage by oil or petrol and is better than natural rubber in resistance to heat, light and oxidation, although inferior to it in resistance to steam, alkalis and acids. 'Paracon' can be worked with ordinary rubber machinery. In its raw state it is highly plastic and unusually well adapted to moulding into intricate shapes and to use in producing rubberized fabrics. 'Paracon' does not compete with other synthetic rubbers for its basic raw materials since the chemical intermediates required for its production are derived by other trains of chemical processes. For its synthesis it uses materials derived from agricultural products and coal products, or from coal and petroleum sources, and in each case by a variety of different chemical processes. The equipment for manufacturing 'Paracon' differs from that required for synthetic rubber production and, consequently, the new material can add to the present supply of rubber substitutes without interfering with the production of those already under way. The synthesis of 'Paracon' was accomplished by Drs. C. S. Fuller and B. S. Biggs of the Bell Laboratories and their associates.

Public Health in Peru

THE February issue of the *Boletin de la Oficina Sanataria Panamericana* contains an article on public health in Peru by Dr. Manuel Prado, president of the Republic, who states that during 1941–42 more attention has been given to it by the Government than ever before. Owing to the general census of 1940 much more accurate data have been made available. The birth-rate, for example, is now found to be rising in many of the provincial capitals, while the death-rate remains unchanged in most of the villages. Considerable attention has been given to children. In addition to the Children's Hospital, which receives children not only from Lima but also from neighbouring villages and towns, there is a National Children's Institute which has made possible the creation in various cities of sections of maternal aid, social hygiene, maternal education and food dispensaries. An intense campaign has been carried out against disease, especially tuberculosis and malaria. Clinics for tuberculosis have been established in three cities and others will soon be formed. A portable X-ray apparatus has been provided for rural communities as well as other means for the diagnosis and treatment of this disease. The Rockefeller Foundation is now collaborating with the Peruvian Ministry of Health in an effort to free the valleys of the coast from malaria. Preventive measures are reducing the foci of other diseases, particularly venereal diseases. First-aid services are assuming greater importance not only for minor accidents but also for major catastrophes. The value of sanitary engineering has recently been proved by its control over bathing establishments and markets, and over food, especially milk.

Narcotic Drug Addicts

IN Supplement No. 170 of *Public Health Reports* Dr. Michael J. Pescor, assistant surgeon, United States Public Health Service, records a follow-up study of 4,766 narcotic drug addicts who had been discharged from the United States Public Health Service Hospital at Lexington, Kentucky, during January 1, 1936–December 31, 1940. The results were as follows: The present state could not be determined in 39·6 per cent of the cases; 7·0 per cent died after discharge; 39·9 per cent returned to the use of drugs and 13·5 per cent were still abstinent. Excluding the dead and the unknown, 74·7 per cent had relapsed and 25·3 per cent were still abstinent. 57 per cent of the patients gave no history of subsequent admission to any institution; 19·9 per cent were re-admitted to other institutions, 16·0 per cent returned to the Lexington Hospital only and 7·1 per cent were re-admitted both to the Lexington Hospital and other institutions. According to Pescor the theoretically ideal patient, that is the one with the best prospects for a permanent cure, is the one who stays in the hospital for 2–5 months, after which he is discharged on parole for a period of supervision of 2–5 months, during which he would have home employment.

Poliomyelitis in the Argentine

ACCORDING to the *Journal of the American Medical Association* of February 6, the number of cases of acute poliomyelitis in the Argentine since last November was greater than in previous epidemics and the course of the disease has been similar to that of the 1936 epidemics. About four hundred cases were reported in two months in the epidemic area, in which more than seven hundred cases were observed during the whole epidemic period of five months in 1936. Separate wards and six hundred beds in various hospitals have been reserved for cases of the disease. Good results have recently been reported from the use of tetanus toxin.

Prevention of Blindness

THE Department of Health for Scotland has recently issued a circular containing the following advice to local authorities on the prevention of blindness: (1) A wider use should be made of special schools and classes for children whose eyesight is defective, arrangements being made with neighbouring authorities when necessary. (2) There should be a closer connexion with industrial medical services to ensure that children leaving school and entering industry are not given jobs making heavy demands on defective eyesight. (3) Facilities for expert consultation and treatment of infections responsible for blindness should be increased. (4) Travelling expenses should be defrayed to treatment centres, of both the patient and a companion.

The Faraday Society

THE Faraday Society has arranged a discussion on "Modes of Drug Action", to be held at the Hotel Rembrandt, London, S.W.7, on September 24. There will be morning and afternoon sessions, at which introductory addresses will be given by Prof. J. H. Gaddum and Prof. E. K. Rideal, devoted respectively to biological and physico-chemical aspects of the subject.

Association for Scientific Photography

THE first meeting of the session for 1943–44 of the Association for Scientific Photography will be held on September 18 at the Middlesex Hospital, London, W.1, to discuss papers on clinical photography. Future meetings will be held monthly; the October meeting will deal with the use of photographically sensitized metal, wood and plastics in industry, the November meeting with oscillographic recording, and the December meeting will be devoted to an exhibition of scientific photographic apparatus arranged jointly with the Scientific and Technical Group of the Royal Photographic Society. Further particulars can be obtained from the honorary secretary of the Association, Tavistock House North (1st floor), Tavistock Square, London, W.C.1.

ASLIB Conference

THE ASLIB Conference, 1943, to be held in the rooms of the Royal Society, Burlington House, London, W.1, during September 18–19, has been designed to provide a platform for discussion of some of the outstanding problems of the rehabilitation of special library and information services after the War, chiefly to give a lead to immediate action. The whole of Saturday afternoon has been given to a symposium on rehabilitation and it is hoped that the discussion will bring the British, American and European needs and opportunities into proper relationship. At the inaugural meeting of the Conference, Prof. J. D. Bernal, as a man of science who has always placed a high value on the positive function of information services at the centre of scientific activity, will draw a picture of what must be expected of information services if they are to fulfil this positive function in the scientific life of the post-war world. Further information can be obtained from the Secretary, ASLIB, 31, Museum Street, London, W.C.1.

Miners' Welfare Scholarships and Exhibitions

THE Trustees of the Miners' Welfare National Scholarships and Students' Exhibitions Funds announce the award of nineteen scholarships and nine exhibitions in 1943, as follows:

Scholarships:

Francis D. Davies, of Dinnington, Yorkshire, tenable at the University of Sheffield; Kingsley R. Fox, of Fenay Bridge, Yorkshire, tenable at the University of Leeds; Geoffrey F. Gill, of Barnsley, Yorkshire, tenable at the University of Sheffield; Raymond Hall, of Bakestone Moor, Nottinghamshire, tenable at the University of Sheffield, for honours degree courses in mining; Robert H. Kirkup, of Radcliffe, Northumberland, tenable at King's College, University of Durham, for an honours degree course in electrical engineering; Edward M. Robson, of Monkseaton, Northumberland, tenable at King's College, University of Durham, for an honours degree course in mining; Ernest Blewitt, of Cudworth, Yorkshire, tenable at Selwyn College, University of Cambridge, for an honours degree course in natural science; Ben R. Brown, of Swinton, Yorkshire, tenable at the University of Manchester, for an honours degree course in chemistry; Jeffrey Ellison, of Old Sharlston, Yorkshire, tenable at the University of Leeds, for an honours degree course in colour chemistry; James B. Finean, of Wombwell, Yorkshire, tenable at the University of Birmingham, for an honours degree course in chemistry; Thomas G. Griffiths, of Cilfrew, Glamorganshire, tenable at Queen's College, University of Oxford, for an honours degree course in modern languages; Jean Haswell, of Clipstone, Nottinghamshire, tenable at the University of Reading, for an honours degree course in English; Joseph Hutchinson, of Kimblesworth, Co. Durham, tenable at King's College, University of Durham, for a degree course in dental surgery; Harry O. Morton, of Balby, Yorkshire, tenable at King's College, University of Cambridge, for an honours degree course in natural science; Thomas A. I. Tees, of Twyn, Carmarthenshire, tenable at the University College, Cardiff, for a degree course in medicine; Mavis Sheppard, of New Ollerton, Nottinghamshire, tenable at King's College, University of London, for an honours degree course in English; Gordon B. Skingle, of Chesterfield, Derbyshire, tenable at University College, Durham, for an honours degree course in modern languages; Graham Turner, of Shuttlewood, Derbyshire, tenable at Queens' College, University of Cambridge, for an honours degree course in natural science; Paul A. N. Wainwright, of Billinge, Lancashire, tenable at the University of St. Andrews, for a degree course in medicine.

Exhibitions:

Harry Allison, of New Herrington, Co. Durham, tenable at King's College, University of Durham, for an honours degree course in agriculture; Drummond H. Bowden, of Abercynon, Glamorganshire, tenable at the University of Bristol, for a degree course in medicine; Bridget Cairns, of Kelty, Fifeshire, tenable at the University of Edinburgh, for an honours degree course in physics; Henry P. Clement, of Willington, Co. Durham, tenable at King's College, University of Durham, for an honours degree course in chemistry; Kathleen M. Dawson, of Newbiggin-by-Sea, Northumberland, tenable at St. Hilda's College, University of Durham, for a course for the diploma in education; David Jenkins, of Llanharan, Glamorganshire, tenable at the University College of Wales, Aberystwyth, for an honours degree course in geography; Betty M. Linford, of Royston, Yorkshire, tenable at Newnham College, University of Cambridge, for an honours degree course in history; Jean M. McLachlan, of Girvan, Ayrshire, tenable at the University of Glasgow, for an honours degree course in chemistry; Henry A. Rigby, of Swinton, Yorkshire, tenable at Exeter College, University of Oxford, for an honours degree course in chemistry.

ERRATUM. In the article "Edmond Halley and Geomagnetism" in NATURE of August 28, on p. 232, col. 1, line 6, for "shell" read "skill".

LETTERS TO THE EDITORS

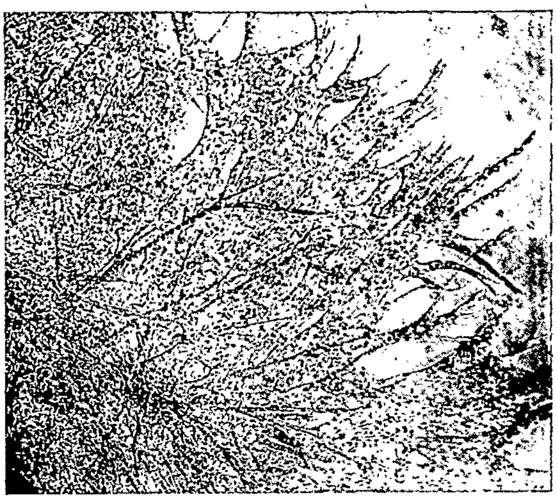
The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Long-term Cultivation *in vitro* of a Dibenzanthracene Mouse Sarcoma

ATTEMPTS to culture *in vitro* over long periods chemically induced sarcomas appear to have met almost universally with failure[1,2]. It seems therefore justified to report briefly on a pure *in vitro* strain of fibroblastic sarcomatous cells, derived from a dibenzanthracene mouse tumour, which was kept *in vitro* for slightly more than two years. The special architecture of these colonies described in a previous communication[3] was maintained with little variation throughout the culture period. The figure shows part of such a colony after 703 days of *in vitro* growth. The cultures were kept in Carrel flasks (coverslip passages, except in a few initial ones, were unsuccessful) in a dilute hen plasma coagulum containing 5 per cent chick embryo juice, and were fed twice weekly with a hen serum (0·2 c.c.)–chick embryo juice (0·05 c.c.)–Tyrode (0·55 c.c.) mixture. Transplantations were made according to the state of health, the cultures being examined daily. When the cultivation was discontinued, the strain had reached its thirty-eighth passage.

Great fluctuations in extent of growth and viability were experienced. As these cells practically fail to liquefy the coagulum, it was found essential to ensure a removal—as thorough as possible—of the aged adherent plasma clot because of its inhibitory action[4]. This was achieved either by mechanical manipulation under a dissecting microscope or by a short trypsin digestion as used by Vogelaar and Erlichman[5] for other types of cultures. The latter treatment was sometimes followed by a quicker and more vigorous outgrowth, and sometimes by complete disintegration; a number of cultures were lost in this way. The presence or the gradual formation in some sera of a substance toxic to these tumour cells, but not to homologous macrophages, was another source of danger to the life of these cultures. Therefore samples of different sera had to be kept in store. If the cytolytic action of a serum was discovered in time when only the peripheral cells had been affected, replacement of the deleterious serum by an innocuous one would result in recovery and save the cultures. The latent period (that is, time elapsed until the first cells wander out into the new coagulum), which is only a few hours from fresh tumour explants, became considerably lengthened with life *in vitro*, and was, during the last months, two days or more, during which time the cultures look almost like dead pieces of tissue.

The rate of *in vitro* growth is very slow compared with normal chick embryo fibroblasts. Area measurements made on sister cultures showed a fair agreement which would encourage closer quantitative work on these cultures were it not for the great difficulty of having cultures available in sufficient numbers. At its best the strain comprised about thirty cultures at a time, all derived from a single original culture.



SARCOMA CULTURE (*Fl* 10385*b*) LIVING, AFTER 703 DAYS *in vitro*; 31ST PASSAGE, 10 DAYS AFTER LAST TRANSFER. × 55.

Inoculations made from time to time of cultures into mice reproduced in some instances the original sarcoma, but the frequency of takes decreased with time of *in vitro* cultivation. After 393 days of *in vitro* growth, even a massive dose (5 cultures per mouse) injected into three animals failed to produce a tumour. The impossibility of increasing the strain substantially during the second year of cultivation prevented further inoculation tests apart from two cultures which were finally left and injected into a mouse; again no tumour resulted. It is difficult to account for these failures. Neither Ludford's[2] contention that the presence of macrophages is an essential feature in the invasive growth of tumours, nor Earle and Voegtlin's[6] tentative suggestion, put forward in a slightly different context, that the foreign medium employed might be responsible for the lack of takes, seems to afford a tenable explanation, as repeatedly some sarcomas were produced, in these studies, from pure fibroblastic sarcomatous colonies grown in an entirely heterologous medium during the first year. It seems possible to relate the failure of takes to the very long latent period observed *in vitro* after transplantation. If there is a similar delay after inoculation into an animal, the culture cells might die before they gain a foothold and/or the animal would be enabled to mobilize in sufficient strength its defence apparatus (leucocytes and antibodies) to cope effectively with the culture material introduced. Alternatively, it has to be assumed that the sarcoma cells have lost their malignancy or what power of autonomous growth they possessed. It must remain for future investigations to throw light on this problem.

I wish to thank the Birmingham Branch of the British Empire Cancer Campaign for a grant which supported this work.

F. JACOBY.

Department of Physiology and
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Birmingham, 15.
Aug. 3.

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[1] Lewis, W. H., *Arch. exp. Zellf.*, **23**, 8 (1939).

[2] Ludford, R. J., *Brit. Med. J.*, 201 (1940).

[3] Jacoby, F., NATURE, **146**, 301 (1940).

[4] Olivo, D. M., *Monit. zool. ital.*, 42 Suppl., 147 (1932).

[5] Vogelaar, J. P. M., and Erlichman, E., *Amer. J. Cancer*, **35**, 510 (1939).

[6] Earle, W. R., and Voegtlin, C., *Publ. Health Reports*, **55**, 303 (1940).

A Serum that Discloses the Genotype of some *Rh*-Positive People

THE blood-group antigen *Rh*, present in the red blood cells of about 85 per cent of normal people, called *Rh*-positive, and absent in the rest, *Rh*-negative, plays, with its corresponding anti-*Rh* agglutinin, an important part in the causation of erythroblastosis fœtalis, a familial disease of the new-born. In about 90 per cent of cases of the disease the mother is *Rh*-negative and has made anti-*Rh* which passes through the placenta and damages the red blood cells of her *Rh*-positive fœtus. The *Rh* factor is inherited as a dominant character with three genotypes *RhRh*, *Rhrh* and *rhrh*.

Recently we have found in the serum of the *Rh*-positive mother of an erythroblastotic baby an agglutinin capable of disclosing the genotype of some *Rh*-positive people. This serum, sent to us by Dr. A. J. McCall as containing anti-*Rh* and yet being from an *Rh*-positive mother, we call *St* from the first two letters of the mother's surname. It reacts with the blood of all *Rh*-negative and of all heterozygous *Rh*-positive persons, *Rhrh* (recognized by being *Rh*-positive parents or children of *Rh*-negative subjects), but it fails to react with about 20 per cent of bloods all of which must, therefore, be homozygous, *RhRh*, and represent about half of the *Rh*-positive homozygotes (about 38 per cent of the population). The *St* serum is somewhat similar to the anti-*Hr* serum found by Levine, Javert and Katzin, and referred to by Wiener[1]. The latter serum, like *St*, reacted with all *Rh*-negative bloods, but whereas *St* failed to react with only 20 per cent, the anti-*Hr*, apparently, failed with about 50 per cent of people[2]. Our findings with *St* serum, and family details, are given below.

	St+	*St*—	Total
General population	173	45	218
Rh-negative bloods	100	0	100
Rh-positive heterozygous bloods	32	0	32

Mrs. St.	*O.MN. Rh+. St—.*
Mr. St.	A_1*.MN. Rh+. St+.*
Eldest son	*O.N. Rh+. St+.*
2rd son	Died of erythroblastosis fœtalis.
3rd son	*O.MN. Rh+. St+.*, recovered from erythroblastosis fœtalis.

It follows that certain rules can be formulated concerning parentage in general:

(*a*) An *St*-negative child must have both parents *Rh*-positive. (*b*) All children of an *St*-negative parent must be *Rh*-positive.

In families with erythroblastosis fœtalis due to anti-*Rh*:

(1) All mothers and children must be *St*-positive. (2) The only member who can be *St*-negative is the father. We have found no exception to these rules. (3) The father will be more frequently *St*-negative, since he is always *Rh*-positive, than will fathers of normal children. (4) If a father is *St*-negative he must be homozygous, *RhRh*, and so cannot produce an *Rh*-negative child. His chance of producing a child without the disease is, therefore, extremely remote. (5) If the great majority of fathers of erythroblastotic infants are homozygous, a conclusion to which we and our collaborators have been led by other observations[3], about half of them should be *St*-negative. We have so far found eight out of twenty-one to be *St*-negative. The examination of a larger number should show the extent of any preponderance of homozygous fathers.

There is ample evidence that there occur subgroups of *Rh* somewhat similar to those of the *ABO* system of groups, and to explain the findings that have been reported[1-4], it is certainly necessary to postulate three allelomorphic genes (Rh_1, Rh_2 and *rh*) and almost certainly four (Rh_1, Rh_2, Rh_3 and *rh*). It is tempting to equate the frequency of the genotype Rh_1Rh_1 to 0·20, the proportion of people whose cells fail to react with the *St* serum. If the frequency of the gene Rh_1 is so derived, it may be estimated that people of the genotypes Rh_2Rh_2 and Rh_2rh form about one sixth of all *Rh*-positive persons. It is noteworthy also that Wiener[1], from the behaviour of an anti-*Rh* serum that failed to react with about 16 per cent of *Rh*-positive bloods, thought that one sixth of all *Rh*-positives belonged to the 'subtype' Rh_2.

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Emergency Public Health Laboratory Service.
Aug. 17.

[1] Wiener, *Amer. J. Clin. Path.*, 12, 302 (1942).

[2] Levine, Katzin, Vogel and Burnham, in "Blood Substitutes and Blood Transfusion", p. 317 (Springfield, Illinois: Mudd and Thalhimer, 1942).

[3] Race, Taylor, Cappell and McFarlane, *Brit. Med. J.* (in the press).

[4] Levine, *J. Hered.*, 34, 71 (1943).

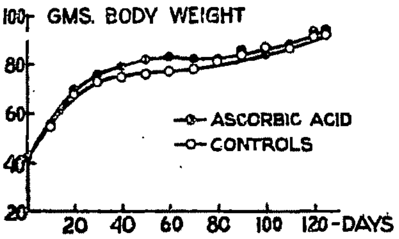
Vitamin C Requirements of the Syrian Hamster

WHILE engaged in some endocrinological and immunological work on the Syrian hamster, we became interested in the diet of this animal. It was thought of interest to examine the ascorbic acid requirements of the hamster, because if the animal required this vitamin, the hamster might be a useful animal for vitamin C studies since it reproduces and matures so rapidly, and is susceptible to many infections not easily produced in other animals. Since we started this study, Routh and Houchin[1] have concluded that thiamin, riboflavin, pyridoxin, pantothenic acid and nicotinic acid are essential in the diet of the hamster, while Cooper, Waisman and Elvehjem[2] have concluded that biotin and possibly inositol and *p*-aminobenzoic acid, in addition to thiamin, riboflavin, pantothenic acid, pyridoxin, and choline, are essential to the hamster, but that nicotinic acid and ascorbic acid are not. Since no growth curves have been published, we think the present study would be of interest.

The experiments were limited to the single substance ascorbic acid, using a diet containing adequate amounts of other growth essentials.

Procedure: Twenty male hamsters 3–5 weeks old were obtained from a commercial dealer (Henry Bergman, Springfield, Missouri). They were divided into two groups of ten each and of equal weight distribution, average body weight 42 gm., and fed *ad libitum* on a diet with and without added ascorbic acid. The diet was of the following composition:

Dextrose (corn sugar)	50
Casein (vitamin-free)	20
Dried brewer's yeast	10
U.S.P. 11 salt mixture	2
Cod liver oil	2
Corn oil (Mazola)	9
Lard	7
	100



GROWTH-RATES OF MALE HAMSTERS WITH AND WITHOUT DIETARY ASCORBIC ACID.

The diet was made in one kilogram lots at a time, and divided into halves. To one half (500 gm.) was added 3·5 gm. of ascorbic acid. The diet was stored under refrigeration and was analysed for ascorbic acid periodically. At no time did the ascorbic acid content of the diet drop below 4 mgm. per gm. The diet was offered in small porcelain feeders (the "Fisher feeder"). One group was fed the diet plus ascorbic acid, and the other group was fed the plain diet. The food intake and animals were weighed daily for the first week and then every other day until the termination of the experiment. The ten animals of each group were caged together.

Results and conclusions: The accompanying graph shows the average growth-curves of the twenty male hamsters on the diet with and without ascorbic acid. The food intake averaged 3·5 gm. per animal per day after the first thirty days of the experiment, making the ascorbic acid intake of the ascorbic group at least 14·0 mgm. per animal per day. There was no appreciable difference in the growth-curves, health and appearance of the two groups. The average weight increase for the first thirty days was 1·07 gm. per day, as compared with 1·05 gm. per day quoted by Cooper *et al.*[2] for hamsters on a synthetic diet. From this it was concluded that the hamster does not require the addition of ascorbic acid to its diet. Others[2,3] have made the same observation, but no growth-curves were presented.

The investigation was supported in part by a grant from the Graduate School of the University of Minnesota. We wish to express our thanks to Marion B. Clausen for her assistance in caring for the animals, and Mr. John Kaster, who determined the ascorbic acid content of the diets.

DONALD F. CLAUSEN.
WILLIAM G. CLARK.

Department of Zoology,
University of Minnesota,
Minneapolis.
July 12.

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[1] Routh, J. I., and Houchin, O. Boyd, *Fed. Proc.*, 1, 191 (1942).

[2] Cooper, J. H., Waisman, H. A., and Elvehjem, C. A., *Proc. Soc. Exp. Biol. and Med.*, 52, 250 (1943).

[3] Routh, J. I., personal communication, supplementing ref. 1.

A Dimastigamœba in the Bed of the Dead Sea

PROFILES of mud samples taken from different places and depth in the Dead Sea were inoculated nto enrichment cultures prepared in Detmer media, 1 : 2, containing different salt concentrations: 0, ½, 1, 3, 6, 9, 12, 15, 18, 25, 75 per cent Dead Sea water and also in Dead Sea water. All the cultures were exposed to electric light; temperature, 25–30° C.

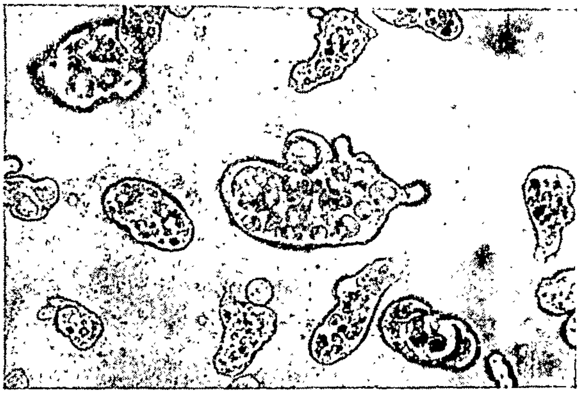

Fig. 1. DIMASTIGAMŒBA OF DIFFERENT SHAPE AND SIZE FROM AN ENRICHMENT CULTURE INOCULATED WITH MUD SAMPLES TAKEN AT A DEPTH OF 330 M. UNSTAINED PREPARATION. × 360.

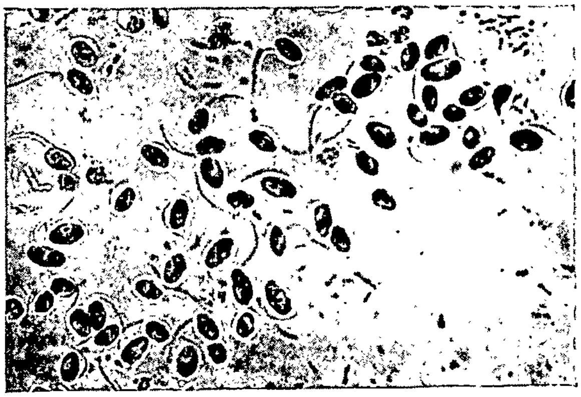

Fig. 2. GREEN FLAGELLATES WITH A SINGLE FLAGELLUM ARISING FROM THE SIDE OF THE CELL. UNSTAINED PREPARATION. × 800.

Rich growth of blue-green algæ was seen in the different salt concentrations. In most of the mud samples the phytoflagellate *Dunaliella viridis* Teod., previously described[1,2], was found. In addition, a very similar green flagellate with a pink eye spot at the posterior end was isolated from a mud sample taken from a depth of 315 m.

In four of the enrichment cultures containing 9, 12, 15, 18 per cent salt, and inoculated with a mud sample from a depth of 330 m. (s.g. 1·222; temperature, 17·5° C., total salt, 31·6 gm. per 100 c.c.), rich growth of amœbæ and cysts were observed after 2½–3 months.

The amœba (Fig. 1) lives in association with a green flagellate and a blue-green algæ. The small green flagellate (Fig. 2)—2–3μ × 4–6·5μ—has a single flagella arising from the side of the cell and a small pink eye spot. The organism is very actively motile with the flagella in its back. The blue-green alga appears in single cells, pairs or short chains, and probably belongs to the genus Aphanocapsa.

The amœbæ vary much in size from 7–54μ by 17–80μ. They are fairly actively motile.

The amœba readily grows in the light in Detmer media, 1 : 2, containing 15 per cent salt plus 15 per cent Dead Sea mud plus 0·02 per cent peptone. Its main food is the green flagellates and the blue-green algæ; cannibalism is rather common.

It was possible to grow the amœbæ in the dark in a semi-solid medium (2 parts agar 3 per cent plus 8 parts liquid media) containing Detmer 1 : 2—15 per cent salt, 0·02 per cent peptone, and a very small

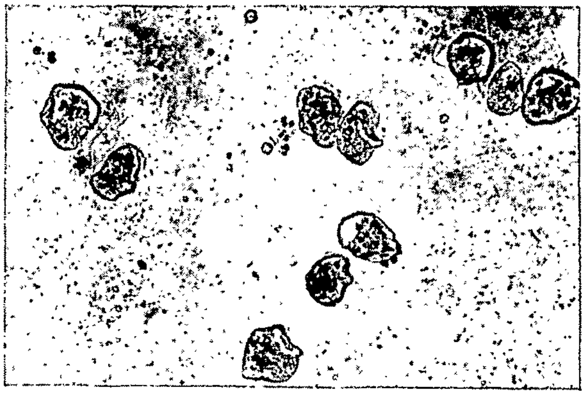

Fig. 3. A FLAGELLATE STAGE OF THE DIMASTIGAMŒBA. UNSTAINED PREPARATION. × 360.

amount of rice starch which was added before inoculation ; temperature, 30° C.

The optimum salt concentration is 15–18 per cent. However, the amœbæ survive in saturated solution ; they multiply slowly in 6 per cent salt.

The characteristic feature of the amœba is its ability to develop flagella under still undetermined conditions and to behave as a flagellate. The flagellates are round or slightly oval (11–25μ × 16–27μ), having a cytostome and two, four, six or rarely eight flagella (Fig. 3). They are very actively motile.

Full details will be published elsewhere.

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Rehovoth, Palestine.
May 14.

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Numerical Fourier Analysis to Twenty-Nine Harmonics

THIS method uses material developed and made available by C. A. Beevers and H. Lipson[1] for computing Fourier syntheses, which has been found to be readily adaptable to the inverse process of analysis. It is applicable to the analysis of periodic functions in which the amplitudes of harmonic components of thirtieth and higher order are negligible. It gives resolution up to the twenty-ninth harmonic and amplitudes accurate to 1 per cent of the largest component.

The harmonic function $y(x)$ having period l may be written

$$y(x) = A_0 + \sum_n A_n \cos 2\pi n \frac{x}{l} + \sum_n B_n \sin 2\pi n \frac{x}{l},$$

in which the cosine series includes terms up to the thirtieth, the last being of negligible amplitude, and the sine series includes terms up to the twenty-ninth. This form of expression, and the number of constants included, is dictated by the method of analysis ; all quantities determinable by the method have been introduced into the equation. The problem of analysing the given function $y(x)$ resolves itself into the determination of the sixty quantities A_0 and all A_n and B_n.

By the method of Bessel[2], these sixty quantities may be determined when the values assumed by $y(x)$ are known (say to 1 per cent of the largest ordinate) for sixty values of x taken at successive intervals of a sixtieth of a period. Let the values of x be denoted by $\frac{ml}{60}$, where m assumes in succession al integral values in the range $0 \leqslant m \leqslant 59$, and let the known corresponding values of $y(x)$ be denoted by y_m. Bessel's solution is

$$A_0 = \tfrac{1}{60} \sum_{m=0}^{59} y_m;$$

$$A_n = \tfrac{1}{30} \sum_{m=0}^{59} y_m \cos 2\pi \frac{nm}{60},\ 1 \leqslant n \leqslant 29,$$

$$A_{30} = \tfrac{1}{60} \sum_{m=0}^{59} y_m \cos 2\pi \frac{30m}{60},$$

$$B_n = \tfrac{1}{30} \sum_{m=0}^{59} y_m \sin 2\pi \frac{nm}{60}.$$

Here A_0 may be written for purposes of computatio as

$$A_0 = \tfrac{1}{60} \sum_{m=0}^{59} y_m \cos 2\pi \frac{nm}{60},\ n = 0.$$

The quantities to be determined are summations o sixty terms, each of the form $C_m \begin{smallmatrix}\sin\\ \cos\end{smallmatrix} 2\pi \frac{nm}{60}$, wher n and m are integers such that $0 \leqslant n \leqslant 30$ an $0 \leqslant m \leqslant 59$.

The functions $C_m \begin{smallmatrix}\sin\\ \cos\end{smallmatrix} 2\pi \frac{nm}{60}$ are the function tabulated by Beevers and Lipson on their sine an cosine strips. Their values are given to the neares integer for all values of C_m from 1 to 99. The argu ment $2\pi \frac{nm}{60}$ is symmetrical with respect to n and m tabulated values of the functions are given for range of 0 to 15 for one integer and of 0 to 20 for the othe To use the strips for the purpose of analysis, eac strip may be taken as a row of entries for given C and m for all values of n from 0 to 15. Since th functions $\begin{smallmatrix}\sin\\ \cos\end{smallmatrix} 2\pi \frac{nm}{60}$ are either symmetrical or ant symmetrical about the value $n = 15$ according as tl functions are non-zero or zero for this value, tl extension of the functions to $n = 30$ can be mechani ally carried out at a convenient stage in the calcul tions.

The symmetries of $\begin{smallmatrix}\sin\\ \cos\end{smallmatrix} 2\pi \frac{nm}{60}$ about the valu $m = 30$ and $m = 15$ may be applied to reduce tl m-summations from 60-term summations to sun mations of 14, 15 or 16 terms taken over the fir quarter period of $\begin{smallmatrix}\sin\\ \cos\end{smallmatrix} 2\pi \frac{nm}{60}$. The symmetries are shown in the accompanying table.

Group \ m =	30	15	Amplitude notation fo quarter perio summations
Cos $2\pi \frac{nm}{60}$, n even	symmetrical	symmetrical	d_0 to d_{15}
,, n odd	symmetrical	anti-symmetrical	e_0 to e_{14}
Sin $2\pi \frac{nm}{60}$, n even	anti-symmetrical	anti-symmetrical	f_1 to f_{14}
,, n odd	anti-symmetrical	symmetrical	g_1 to g_{15}

Thus

$$(n \text{ even}) \sum_{m=0}^{59} y_m \cos 2\pi \frac{nm}{60} = \sum_{m=0}^{15} d_m \cos 2\pi \frac{nm}{60}$$

$$(n \text{ odd}) \sum_{m=0}^{59} y_m \cos 2\pi \frac{nm}{60} = \sum_{m=0}^{14} e_m \cos 2\pi \frac{nm}{60}$$

$$(n \text{ even}) \sum_{m=0}^{59} y_m \sin 2\pi \frac{nm}{60} = \sum_{m=1}^{14} f_m \sin 2\pi \frac{nm}{60}$$

$$(n \text{ odd}) \sum_{m=0}^{59} y_m \sin 2\pi \frac{nm}{60} = \sum_{m=1}^{15} g_m \sin 2\pi \frac{nm}{60}$$

The procedure is now as follows. Select from the box of strips the fourteen, fifteen or sixteen strips required for one group of summations. Separate these into two sets according as the value given on the strip for $n = 15$ is zero or non-zero and arrange the two sets separately for addition of the columns of constant n. If an n-even group is being worked, total the columns for $n = 0, 2, 4 \ldots$ in both sets; if an n-odd group is being worked, total the columns for $n = 1, 3, 5 \ldots$ in both sets. The totals for the two sets must be added according to columns to give the summations up to the fifteenth order of n. The totals for the two sets must be subtracted to give the higher orders of n in descending order, the anti-symmetric set being subtracted from the symmetric set.

The following simple checks are applicable (subsidiary checking is desirable for amplitude calculations and strip selection):

$$\sum_{n=0}^{30} A_n = y_0;$$

$$\sum_{n=1}^{29} B_n \sin 6n^0 = \tfrac{1}{2}(y_1 - y_{59});$$

$$\sum_{\substack{n=0 \\ n \text{ even}}}^{30} (-1)^{n/2} A_n + \sum_{\substack{n=1 \\ n \text{ odd}}}^{29} (-1)^{(n-1)/2} B_n = y_{15}.$$

The whole process of computing and checking can be carried through for twenty-nine harmonics in less than two hours. The method has proved satisfactory in regular use and has been found less tiring than the process of curve tracing necessary in machine analysis. Except for convenience in checking, no more harmonics need be determined than are actually required. The procedure can be quickly learnt, errors are not liable to occur, and the calculations, including checking, can be performed almost entirely on an adding machine.

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[1] *Proc. Phys. Soc.*, **48**, 772 (1936). NATURE, **137**, 825 (1936).

[2] Whittaker and Robinson, "Calculus of Observations", pp. 264 *et seq.*

MISS ROSS has done a useful service in directing attention to the value of the Beevers-Lipson strips for the process of Fourier analysis. These strips were originally designed for Fourier synthesis in crystal-structure determination, and for this purpose printed copies have been supplied to some forty crystal-structure laboratories (a few copies of the uncut tables are still available from this address). It seems likely, however, that the application to Fourier analysis is of rather wider interest. Prof. Max Born suggested this use of the strips to us some years ago, but it was only after inquiries by other workers, and finally by hearing of the successful work of Miss Ross, that we have come to realize that the strips provide by far the most convenient practical method of Fourier analysis available in an ordinary laboratory.

The Fourier machine which we have recently described[1] will perform the same work as the strips, and would therefore carry out the process described by Miss Ross. It would enable the user to go from the numerical values of the y_m to the twenty-nine Fourier coefficients in a time of less than eight minutes. Even faster working would be permitted by a minor extension of the machine so as to attain a wave-number of 30 instead of 24 as at present, and a machine working with similar components but with thirty-one counters and going up to a wave-number of 60 would enable the operator to complete the whole process in about three minutes. There may be applications of Fourier analysis where this extreme speed is desirable. Checking could be readily carried out by re-synthesis of the function.

The process can be done, of course, on a commercial scale by the use of the Hollerith series of tabulating machines, but these are considerably slower than the Beevers machine, although they provide a flexible and reliable method.

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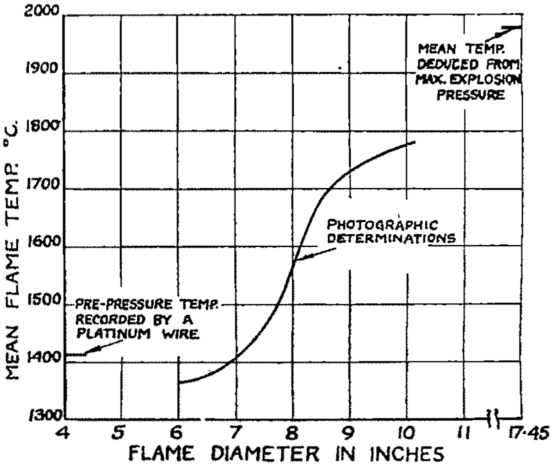
[1] Beevers, *Proc. Phys. Soc.*, **51**, 660 (1939). Macewan and Beevers, *J. Sci. Instr.*, **19**, 150 (1942).

Temperature Gradients in Gaseous Explosions

A NEW method of determining flame temperatures during explosions in a closed vessel has been evolved. Briefly, the method consists of recording photographically flame travel and simultaneously, by means of a very sensitive diaphragm type of pressure indicator, the pressure rise in a large spherical explosion vessel 17·45 in. in diameter with central



ignition. By correlating flame diameter with pressure rise the mean gas temperature in the burnt portion could be deduced at different instants during the explosion (up to a limiting diameter of 10 in.).

The results obtained with a 10 per cent oxygen plus 90 per cent carbon monoxide mixture are shown in the accompanying graph. Also indicated is the pre-pressure flame temperature measured by means of a platinum resistance thermometer (which in the case of very over-rich mixtures registers the same temperature as a quartz-coated platinum resistance thermometer[1]) and the maximum mean gas temperature obtained from the maximum explosion pressure[2].

It will be noted that the mean temperature rises from a value very much in line with the platinum wire temperature at a diameter of 6 in. up to a value, at 10 in. diameter, approaching the mean temperature inferred from the maximum pressure. This shows that the latent energy[3] in the flame gases diminishes as the flame travels outwards from the spark.

Direct experimental confirmation of David's postulate[4] that the latent energy diminishes with distance of flame travel from the igniting source is thus furnished by the experiment.

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[1] David, Leah and Pugh, *Phil. Mag.*, (7), **31**, 156 (1941).

[2] David and Leah, *Phil. Mag.*, (7), **22**, 513 (1936).

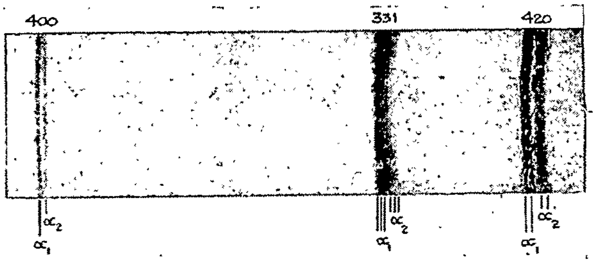
[3] David, "The Abnormality of Flame Gases", *Proc. Inst. Mech. Eng.* (in the press).

[4] *Phil. Mag.*, (7), **23**, 345 (1937).

Structure of Nickel Oxide

The development of modern X-ray powder photographic methods has opened up new possibilities for the examination of the fine structure of crystalline substances. The high resolution and definition of the reflexions, particularly in the high-order lines, which is obtainable with such circular cameras as that described by Bradley, Lipson and Petch[1], has not only meant an increase in accuracy of lattice parameter measurements, but has also enabled interesting phenomena in alloys to be observed[2]. The detection of extra reflexions in powder photographs of graphite[3] has led to the description of a second crystalline form[4], which apparently co-exists with the structure established by Bernal.

Another instance, which depends upon the observation of the fine structure of powder lines, has been noticed during an examination of nickel oxides from various sources. The structure for nickel oxide determined by Cairns and Ott[5] is face-centred cubic with $a_0 = 4{\cdot}1684$ kX., the atomic arrangement being of the sodium chloride type; the lines on a powder photograph taken on a small-diameter camera are distributed in the usual way for a face-centred cubic substance. Photographs of well-crystallized specimens taken on a 19-cm. diameter camera giving highly resolved reflexions show, however, that many of the lines are not simple α-doublets, but are doubled or in some instances tripled. The type of reflexion obtained is shown in the accompanying illustration, which is a reproduction of the high-order end of the pattern with cobalt $K\alpha$-radiation.



Part of X-ray powder photograph (calcium $K\alpha$-radiation, 19 cm. camera) of nickel oxide. × 2.

Photographs taken with various radiations, to enable a sufficient number of (hkl) reflexions to be analysed, indicate that all lines are doubled or have more than one α-doublet component except those with indices $(h00)$.

If the structure of nickel oxide departs very slightly from cubic symmetry in a manner that makes it rhombohedral, the observed modifications of the reflexions can be explained. The distortion is so small that it is difficult to ascertain with complete certainty whether the angle of the unit rhomb is greater or less than the theoretical for cubic symmetry, but a larger value seems most probable when the intensities and separations of the components of all the observable reflexions are taken into account. On this assumption the most probable values for the lattice parameters of the rhombohedral unit cell are, at 20° C., $a_0 = 2{\cdot}9459$ kX., $\alpha = 60° \, 4{\cdot}2'$.

The effect has been observed for nickel oxides of widely different origins, including a variety commonly known as 'black nickel oxide', and is noticeable with feebly crystallized specimens in spite of some broadening of the reflexions owing to small crystal size. It is not obtained with monoxides of the other transition elements iron and cobalt, and indeed the solution of relatively small percentages of these oxides in nickel oxide causes a reduction in separation of the components of the complex reflexions. The asymmetry of the structural unit of nickel oxide may therefore be associated with the slightly smaller effective size of the nickel atom as compared with iron and cobalt; the atomic packing is affected in such a way that there is the equivalent of a small compression of the cubic lattice along a triad axis.

There may well be other crystals, that to a first approximation appear to conform to the isometric system, but would in fact on precision examination be found to possess a less simple structure. Latest refinements in powder photographic technique which permit the fine structure of the reflexion lines to be studied may yield interesting results in this connexion.

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Aug. 3.

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SOME EFFECTS ON LIESEGANG RINGS

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THE observations described below were made in the course of investigations carried out under the auspices of the Sunfield Agricultural Centre, Clent (now the Agricultural Centre, Blairs, Aberdeen), on the sensitivity of Liesegang rings to various influences, undertaken with the view of applying them to certain biological problems.

Formative Catalysis

Liesegang[1] uses the term *Formcatalysator* for potassium dichromate when, through a double reaction, it brings about rings of silver chloride not formed without its presence.

We observed two cases of formative catalysis causing stratification of manganese sulphide. When ammonium sulphide solution is allowed to diffuse into gelatine containing manganese chloride in a test-tube, the latter is deposited almost homogeneously. If small amounts of stannous chloride or copper sulphate are added to the manganese chloride – gelatine, distinct layers separated by completely clear spaces are formed. In the case of stannous chloride the layers begin 8–25 mm. below the surface of the gelatine and continue to be formed throughout the length of the test-tube. Their thickness and the distance between them increase in a regular way similar to the silver chromate layers. The minimal concentration of stannous chloride producing the effect is 10^{-5}, the concentration of the manganese chloride being 10^{-3} and that of the ammonium sulphide 1–2 per cent. Higher concentrations of stannous chloride produce more and thinner layers. The manganese sulphide layers due to the action of copper sulphate begin farther down the tube where diffusion is rather slow. The minimal concentration of copper sulphate still active is 10^{-6} (manganese chloride 10^{-3}, ammonium sulphide 1–2 per cent). In both cases the concentration of the formative catalyst must be increased if higher concentrations of manganese chloride and ammonium sulphide are used.

This effect cannot be explained by a double reaction as in Liesegang's experiment. Stannous chloride and copper sulphate alone form no layers with ammonium sulphide, and the necessary quantities are very small—2·5 γ $Cu^{\cdot\cdot}$ in 10 ml. gelatine, which is of the order of the Feigl spot-test limits.

Of other metal salts, sodium arsenite and chromium sulphate show a similar effect with manganese sulphide, but much weaker than $Cu^{\cdot\cdot}$ and $Sn^{\cdot\cdot}$; $Fe^{\cdot\cdot\cdot}$, $Pb^{\cdot\cdot}$, $Ni^{\cdot\cdot}$, $Co^{\cdot\cdot}$, $Ba^{\cdot\cdot}$, $Mg^{\cdot\cdot}$, $Hg^{\cdot\cdot}$, $Hg^{\cdot}$, $Ag^{\cdot}$, $Zn^{\cdot\cdot}$, $Cd^{\cdot\cdot}$ are inactive.

We observed also a case of negative formative catalysis: lead salts interfere with or prevent the formation of silver chromate layers when added to silver nitrate–gelatine into which potassium dichromate is diffusing. The effect is noticeable with a lead salt concentration of 10^{-5} and stratification is completely prevented at 10^{-4} (silver nitrate 0·5 per cent, potassium chromate 5 per cent). Sodium arsenite at concentration 10^{-4} also prevents formation of silver chromate layers, whereas $Cu^{\cdot\cdot}$, $Sn^{\cdot\cdot\cdot\cdot}$, $Cr^{\cdot\cdot\cdot}$, $Mn^{\cdot\cdot}$, $Zn^{\cdot\cdot}$, $Cd^{\cdot\cdot}$, $Ca^{\cdot\cdot}$, all at concentration 10^{-4}, have no effect. $Fe^{\cdot\cdot\cdot}$ and $Hg^{\cdot\cdot}$ cause a slight disturbance. A similar effect of lead salts at concentration 10^{-4} could be observed in the case of manganese hydroxide layers (8 per cent ammonia diffusing into gelatine containing 0·5 per cent manganese chloride). Here, too, other metals are far less active ($Cu^{\cdot\cdot}$, AsO_3''', $Sn^{\cdot\cdot}$) or inactive ($Ag^{\cdot}$, $Hg^{\cdot}$, $Hg^{\cdot\cdot}$. $Zn^{\cdot\cdot}$, $Cd^{\cdot\cdot}$, $Sn^{\cdot\cdot\cdot\cdot}$, $Cr^{\cdot\cdot\cdot}$, $Ba^{\cdot\cdot}$, $Mg^{\cdot\cdot}$). Other influences, acidity, alkalinity, oxidizing and reducing agents require a higher concentration in order to interfere with the manganese hydroxide layers.

Effects of Mercury Vapour

When a piece of metal sheet (zinc, iron, tin, lead or copper), either superficially amalgamated by spreading mercury on its surface or treated with mercuric chloride solution, is placed 3–5 mm. above a glass plate bearing a layer of 5 per cent gelatine containing 0·1 per cent potassium dichromate in the centre of which a drop of 50 per cent silver nitrate solution has been placed, the silver chromate rings are affected. The plate should be covered and left for 20–30 hours. Three different effects can be observed:

(1) Serious disturbance of the rings, the silver chromate being partly deposited homogeneously or in irregular patches. This effect has been described by Shemyakin[2]. (2) Intensification of the micro-rings. (3) Formation of a new structure on the surface of the gelatine. It consists of straight lines proceeding in a radial direction strictly perpendicular to the micro-rings. There are about 100–150 of them to the millimetre and they can be clearly seen under the microscope. The optical effect is visible to the naked eye as soon as the plate is uncovered after the experiment. Acting as a diffraction grating, a bright spectrum is produced in reflected as well as in transmitted light. Exposure of the plate to mercury vapour for a short period shows that the formation of these radial lines takes place only at the periphery of the expanding diffusion circle. Besides the radial lines, wrinkles are also produced on the gelatine surface. The phenomenon is not of a stable nature and the radial lines get very faint some days after the experiment.

So far the effect has been observed only under the influence of mercury. Lead, iron, tin, zinc, copper, nickel do not produce it. This seems to indicate that it is due to action of the vapour and not to a radiation as suggested by Shemyakin[2].

Effects of Temperature, *p*H, and Light

The structures formed by diffusion of silver nitrate into potassium dichromate–gelatine are influenced by temperature, *p*H and light. In all three cases the effects on the layers are opposite to those on the micro-rings. The concentrations used for these experiments were: 5 per cent gelatine containing 0·1 per cent potassium dichromate; 8·5 per cent silver nitrate as diffusing solution.

Effects on the layers. Increasing temperature promotes layer formation. Whereas only a few layers appear at temperatures between 0° and 10°, a complete series from the gelatine surface down the tube is obtained above 15°.

Alkalinity promotes layer formation at low temperature (0°–10°), where a complete series can be obtained by adding 0·02 per cent sodium hydroxide to the gelatine. Higher alkalinity (0·04 per cent sodium hydroxide) brings about continuous precipitation, but above 0·05–0·06 per cent sodium hydroxide layers are again formed up to 0·3 per cent. Above that concentration continuous precipitation again takes place. Acidity shortens the range of the layers with increasing concentration, leaving only the top ones, and layer formation is prevented altogether above 0·15–0·2 per cent sulphuric acid.

Light at temperatures below 10° slightly reduces the number of layers. At higher temperature no such effect takes place.

Effects on the micro-rings. The formation of micro-rings is disturbed and eventually prevented with increasing temperature. Alkalinity also has a disturbing influence and above 0·04 per cent sodium hydroxide no micro-rings are formed. Acidity promotes the formation of micro-rings, the optimal concentration being 0·02–0·12 per cent sulphuric acid. At higher concentrations their range is reduced and above 0·3 per cent sulphuric acid none is formed.

The most striking influence on the micro-rings is that of light. It is strongly positive and seems to be almost indispensable for their formation. This, however, could not be definitely established; as a few micro-rings near the gelatine surface have been observed in some experiments conducted in the dark even if the chromate gelatine had been prepared in the red light of a photographic developing lamp. But it is certain that at room temperature, with the concentrations mentioned, no micro-rings are formed more than 20 mm. from the gelatine surface without the action of light. If such an experiment, after having proceeded in the dark for at least twenty-four hours, is exposed to strong light for a limited time, micro-rings are formed beginning from the level to which diffusion has gone. Their formation does not cease when the light is removed but continues in the dark for a period the length of which depends on the intensity of the light and the duration of the exposure.

A chromate gelatine containing 5 per cent gelatine, 0·1 per cent potassium dichromate and 0·03 per cent sulphuric acid was prepared in red light and poured into test-tubes which were kept in the dark. On the following day, 8·5 per cent silver nitrate solution was poured on top of the set gelatine. After thirty hours the tubes were exposed to various kinds of light with the following results:

Light source	Time of exposure	Width of belt of micro-rings	Approx. time of micro-ring formation
150-watt bulb at 50 cm. dist.	2 hr.	No micro-rings	—
Daylight	20 min.	No micro-rings	—
Daylight	40 min.	2 mm.	3–4 hr.
Daylight	60 min.	3 mm.	5–6 hr.
Quartz lamp at 25 cm. dist.	7 min.	2 mm.	3–4 hr.
Quartz lamp at 25 cm. dist.	17 min.	20 mm.	2 days

This after-effect of light can be explained by a photochemical change of the chromate gelatine by which conditions for the formation of micro-rings are produced, and which is slowly reversed in the dark. The change itself also seems to take some time if the light is not very strong. In the case of daylight, not with the quartz-lamp, the micro-rings did not appear immediately upon exposure but 1–2 mm. farther down.

We wish to express thanks to the members of the service scheme of the Agricultural Centre, Heathcot House, Blairs, Aberdeen, for their financial help, which has enabled us to carry out the present work.

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SCIENCE UNDER FASCISM AND DEMOCRACY

AT a Conference organized by the Association of Scientific Workers (West Midland Area) in Birmingham, on August 22, scientific workers from nine nations contrasted the position of science, and scientific workers, in countries under fascist and democratic regimes.

The chairman, Dr. W. Wilson, emphasized that the war effort of the United Nations had depended to a very high degree upon the work of men of science, and if the prosperity and health of the world was to be ensured after the War then the role of the man of science would be no less important. Science, however, can only be expected to flourish in a social and political atmosphere which allows freedom of thought. The Lord Mayor of Birmingham (Councillor W. S. Lewis) tendered a civic welcome to the assembled delegates, and expressed the hope that it would be speedily possible to re-establish the scientific life and culture of the occupied countries in Europe which the Nazis are now trying to destroy.

In a message to the conference, Prof. Semon Sarkisov said that the German invaders had already felt the strength of Soviet science in the blows struck by the Red Army. Thanks to their peace-time achievements, and intensive war-time activity, the men of science had enabled the resources of the Urals, Siberia, and Kazakhstan to be put into effective use for the country's war effort. In the sphere of agriculture they had been able to move successfully a number of essential crops from the Ukraine to the eastern regions of the U.S.S.R. Dr. Goebbels had said: "Humanism, culture, and international law are empty words for us". Was it, then, a wonder that German medical science, for example, had not produced anything new for the benefit of mankind during the period of Nazi rule, but on the contrary it had rapidly declined? Hatred of mankind was the basic feature of fascism, which aimed at enslaving the peoples of the world by using a pseudo-scientific ideology based on the would-be superiority of the German race.

A. van Anrooy (Holland) gave an account of the historical growth of science in Holland under the liberal regimes of the seventeenth and eighteenth centuries, this leading to many famous medieval inventions. The Universities of Leyden and Delft had become famous throughout the world, but under the rule of Seiss Inquart they have been closed and the student organizations disbanded. Dr. C. Koeck, speaking for Austria, outlined the disastrous results upon the scientific life of Vienna of the occupation by the Nazis, since science is merely of secondary importance under fascism.

Prof. J. H. Hildebrand (United States) gave personal impressions of German science gained during visits paid to Germany under the regimes of the Kaiser, Republic, and the Nazis, and instanced many scientific absurdities perpetrated by "Aryan scientists". A totalitarian regime cannot permit any challenge to its power, and the freedom to seek and speak the truth is a danger against which it must always be suspicious. Benevolent, enlightened despots have been very few. Men of science must add a fifth freedom to their charter: "the freedom to exercise unquenchable curiosity". They must not be bribed by any false promises of political Messiahs who might interfere with their freedom to seek the truth; they must insist upon asking questions and getting their answers from Nature rather than from a Dr. Goebbels.

Dr. B. Schober (Czechoslovakia) gave details of the destruction of Czechoslovak scientific culture since Nazi occupation, and the persecution of the students and professors following their resistance to fascist domination. The health of the nation is deteriorating rapidly since the food supplies available provide only one- to two-thirds of the essential calories. Mr. P. M. Yap contrasted the scientific spirit in China and Japan, showing that the Japanese treatment of science follows very closely that of Germany. Full scientific progress in China has been retarded in the past by its dependence upon political and social conditions, but at present these are highly favourable and science is receiving the support of both Government and people. Mr. J. J. Ducenne dealt with the general position of science in Belgium before the War, and then gave impressions of the struggle between men of science and the occupying Nazis.

Prof. J. B. S. Haldane paid a tribute to the scientific workers who had been able to escape from occupied countries and were giving us inestimable help in our destruction of fascism. He then dealt with science in the U.S.S.R., stating that the system of planning had enabled the country to mobilize all men of science for the war effort much more quickly than we could. Planning was done largely by men of science in the U.S.S.R., and it was important to realize that the present power of the Red Army was due to scientific planning in the past, particularly in geological research, which employs some two thousand trained geologists. He thought that undoubtedly the Soviet Union had something to learn from Great Britain regarding liberty; similarly we might learn a lot from the Soviets about planning. It was all-important that we should learn how to combine planning and freedom, for that was the key problem of the future. It must be realized that scientific workers are skilled manual workers, and we must resist any attempt by educationists to make a gap between the two. The utmost scientific knowledge must be given to ordinary people.

Dr. G. Fournier (France) showed that it was impossible for the man of science to live remote from politics and the affairs of the world. Too many men of science had said: "I am not interested in politics". Now the politicians have become too interested in the men of science, and as a result many had found themselves in custody, and their books burnt. Science has a social value and the man of science cannot wash his hands of his discoveries. It is his duty to see that they are used for the betterment of mankind, and not for ts destruction. In future he must be continuously alert to ensure that fascism does not reappear under some other name elsewhere in the world.

Dr. J. G. Siebert (Germany) summed up the discussion, and by resolution the meeting sent its greetngs to peoples in subjected countries, and expressed the view that, as rational organization of science for the purpose of waging war would bring victory over the Axis powers, a thorough co-ordination of scientific and technical enterprise could forge weapons to destroy the evils of want, disease, and ignorance which would still have to be confronted when the War was won. The meeting pledged fullest support for 'the impending large-scale decisive invasion of the European continent. We call on all scientists and echnicians to give of their utmost, whether in workshop or in hospital, in laboratory or at the battlefront".

J. S. CLIFF.

CIVILIAN CONTRIBUTION TO EDUCATION IN THE FORCES

THE Report of the Central Advisory Council for Education in H.M. Forces for the period October 1942–March 1943 again directs attention to the remarkable way in which the project is growing. Much of the increase in demand can be explained by the introduction of compulsory educational periods in the Army during training hours for the months November–February. This not only increased the desire for supplementary lectures by experienced civilians but has, principally in Anti-Aircraft Command, called for aid from the university and university college regional committees in giving the suggested talks on citizenship in a number of small units which do not possess suitable teachers within their ranks. Steps taken by the Royal Air Force, and more recently by the Royal Navy, to encourage the study of current affairs, account for an increase in educational activities by these Services proportionately greater than that for the Army.

There has been an increased demand for lectures and classes by many women's units. Efforts have been made to meet this demand by adding lecturers to regional panels who are particularly well equipped to give the personal approach and treatment of subject which is required by audiences of women. At one A.T.S. conference it was revealed that arranging education in women's units is often more difficult than in men's units, but that the A.T.S. could do much more in the way of education if the right subjects and approach could be found. A profitable introduction to citizenship was being made in women's units through their interest in social services.

An interesting development has been the increase in the number of "site visitors". These are men and women who visit small units at regular intervals to guide and advise units on many social and educational matters. Usually the visit takes the form of an informal talk or discussion and is often followed by requests for help or information in regard to all kinds of group or individual activities. The voluntary organizations connected with education have contributed greatly to the success of these site visits.

People who are interested in the development of residential colleges for adult education for the civilian population will find much to interest them in the short schools and conferences which were arranged by the regional committees for H.M. Forces. In the period under review, 126 of these courses, etc., were held, 44 of them being residential. They were attended by 4,398 Service men and women, including members of the U.S. Forces. One of these courses was of three weeks duration and dealt with the basic elements of responsible citizenship, while other courses of the same nature lasted for shorter periods. The experiences gained during these periods of residential study should be of great value to educationists connected with adult work in the post-war period. It should be pointed out that similar courses were arranged for men and women from the Dominions, the fighting services of other members of the United Nations and the merchant navies of Britain and other countries.

The statistics issued in this report show that the number of single lectures given by civilian lecturers was 61,546, an increase of 44 per cent over the previous six months. The number of short courses increased by 15 per cent to 3,223, while the number of continuous classes rose to 1,369, an increase of 35 per cent.

Topics of current interest were responsible for much of the increase, while the increase in non-vocational science and psychology (classified separately) was very considerable. Handicrafts again proved popular and increased in number, but the shortage of materials has hindered the formation of classes in a number of crafts.

The growing volume of work undertaken by the regional committees is a tribute not only to all the individuals who take part in the work but also to the Service authorities for their wisdom in encouraging educational activities among serving men and women.

PROPOSALS FOR NEW BASIC PHYSICAL POSTULATES

IN a series of papers published in 1942, some in the *Manual of Myiology*, Dr. H. T. Townsend, of S. Paulo, Brazil, puts forward a revolutionary set of new physical theories. While there does not appear to be adequate evidence for the views put forward in the papers under notice, the following are principal postulates, mainly in the author's own words:

Centrifugal force is inherent in all cosmogen (mass + motion) and is the most basic cosmic force. Gravity is an equally basic cosmic force. Hence the two are one and the same force. Gravity is the complement of bound centrifugal force. It is unbound centrifugal force. Centrifugal force makes up all cosmogen by its interaction with the actinionic medium. Spinning actinions spinning round a vortex centre are the basis and the electron formed from them spins inherently. Spinning atoms are formed from spinning electrons and spinning molecules from spinning atoms. Centrifugal force centres vary from innumerable microfield centres (vortices in the medium) to the single great cosmic field centre, and each maintains its individual electro-magnetodynamic (commonly called magnetic) field. The repulsions between these fields constitute the force of gravity. Electromagnetic radiation is micro-centrifugal fields in wave formation travelling at top speed in the transmitting (actionic) medium.

The number of atomic weight units in the electronic unit is 546, which thus becomes the basic physical constant. All the atomic weights of the chemical elements are multiples of 546. The actinion carries the force quantum of 12×10^{-30} dyne, the equivalent of the motion of 546 actinions constituting a photon. A photon is pure energy acting on the mass of the transmitting actionic medium. The ultimate force quantum is the dynamion, which on coming in contact with an ultimate mass particle or akinesion at once imparts to it an ultimate energy quantum or kinesion, resulting in an actinion. A photon is 546 kinesions, or the result of 546 liberated dynamions imparting 546 motion units to as many actinions.

Applying the 546-multiple key to the light-velocity problem, it is found that the only number within the limited range of Michelson's (1927) experimental results that is a multiple of the square of 546 is 29979737424, which is also within the Henning and Jaeger corrected range of Rosa and Dorsey's (1907) measurements of the electrostatic unit to the electromagnetic unit ratio in our terms of light velocity. It is Michelson's lower to mean record plus the possible retardation by his mirrors.

FORTHCOMING EVENTS

Saturday, September 11

BRITISH FEDERATION OF BUSINESS AND PROFESSIONAL WOMEN (at the Royal Institution, 21 Albemarle Street, Piccadilly, London, W.1), at 3 p.m.—Dr. Margaret Mead: "Science, Women and the Problem of Power".

Saturday, September 18

BRITISH RHEOLOGIST'S CLUB (at Loughborough College, Loughborough), at 10 a.m.—Discussion on "Rheology in the Hosiery, Leather, Shoe and Allied Trades".

ASSOCIATION FOR SCIENTIFIC PHOTOGRAPHY (at the Middlesex Hospital, London, W.1), at 2.30 p.m.—Discussion on "Clinical Photography".

Saturday, September 18–Sunday, September 19

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (at the Royal Society, Burlington House, Piccadilly, London, W.1).—Eighteenth ASLIB Conference.

Saturday, September 18

10.30 a.m.—Annual General Meeting.
11.30 a.m.—Prof. J. D. Bernal, F.R.S.: "Positive Information Service".
2.0 p.m.—Symposium on "The International Rehabilitation of Special Library Services".

Sunday, September 19

10.30 a.m.—Mr. F. C. Francis: "The British Museum as a Special Library".
11.45 a.m.—Major Irving Newman: "The Organisation of American Photographic Information Services in Great Britain".
2.30 p.m.—Symposium on "The Co-ordination of Abstracting".
5.0 p.m.—"ASLIB: What it is Doing and What it Hopes to Do".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on o before the dates mentioned:

ASSISTANT MASTER TO TEACH ENGINEERING DRAWING in the Middlesbrough Technical School for Boys—The Director of Education, Education Offices, Middlesbrough (September 18).

HEAD OF THE DEPARTMENT OF MATHEMATICS—The Principal, Heriot Watt College, Edinburgh (September 20).

HEADS OF THE DEPARTMENTS OF PHYSIOLOGY, MEDICINE, AND SURGERY—The Bursar, Royal Veterinary College and Hospital, a The University, Reading (October 1).

CHAIR OF NAVAL ARCHITECTURE—The Acting Secretary of Univer sity Court, The University, Glasgow (October 4).

DIRECTOR OF ROBERT GORDON'S TECHNICAL COLLEGE—The Secre tary, Robert Gordon's Technical College, Aberdeen (October 16).

CHIEF CERAMIC RESEARCH CHEMIST—The Ministry of Labour an National Service, Central (Technical and Scientific) Register, Alexandr House, Kingsway, London, W.C.2 (quoting Reference No. O.N.F 1457X).

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

London School of Hygiene and Tropical Medicine (University London) incorporating the Ross Institute. Report of a Meeting o the Ross Institute Industrial Advisory Committee on Thursday 27th May 1943. Pp. 24. (London: London School of Hygiene an Tropical Medicine.) [12

Imperial Agricultural Bureaux. Joint Publication No. 5: Th Production of Seed of Root Crops and Vegetables. Pp. 96. (Eas Malling: Imperial Bureau of Horticulture and Plantation Crops Aberystwyth: Imperial Bureau of Pastures and Forage Crops Cambridge: Imperial Bureau of Plant Breeding and Genetics 3*s*. [13

Institute of Welding. Twentieth Annual Report of the Counci Accounts and Balance Sheet to 31 December 1942. Pp. 20. (London Institute of Welding.) [17

Otto Jespersen: his Work for an International Auxiliary Languag By H. Jacob. Pp. 32. (Loughton: International Language (Id Society of Great Britain.) 1*s*. [18

Other Countries

Proceedings of the Academy of Natural Sciences of Philadelphi Vol. 93, 1941. Pp. iii+336. (Philadelphia, Pa.: Academy of Natura Sciences.) 7.50 dollars. [12

Fifty-eighth Annual Report of the Bureau of American Ethnolog to the Secretary of the Smithsonian Institution, 1940–1941. Pp. 1 (Washington, D.C.: Government Printing Office.) [12

Smithsonian Institution: Bureau of American Ethnology. Bullet 129: An Archaeological Survey of Pickwick Basin in the adjace portions of the States of Alabama, Mississippi and Tennessee. B William S. Webb and David L. DeJarnette; with Additions Walter B. Jones, J. P. E. Morrison, Marshall T. Newman and Charles Snow and William G. Haag. Pp. xxii+536+316 plates. (Washingto D.C.: Government Printing Office.) 2 dollars. [12

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FUNCTIONAL DEVELOPMENT OF INTERNATIONAL ORGANIZATION

DR. W. E. ALLEE'S proposed address as vice-president and chairman of Section F of the American Association for the Advancement of Science, "Where Angels Fear to Tread : A Contribution from General Sociology to Human Ethics", which has recently appeared in *Science* (**97**, 517–525, June 11, 1943) is of special interest in view of current discussions on the establishment of a working peace system and on the problem of Germany. Cumulative studies in social biology lead Dr. Allee to the conclusion that co-operative forces are biologically more important and vital than their opposite. He insists that the data of biology, if properly understood, are definitely opposed to any social philosophy based primarily on the idea that might makes right in international contacts or in international relations.

Prof. Allee believes that a special obligation rests on biologists to attempt to make sure that mankind does not lose the peace that will follow the present War, in which connexion he urges that those nations will have the best opportunity to win the peace who emerge from the present conflict with their programme of basic research most nearly intact. He suggests that the biological drives towards natural co-operation support the general tenor of a programme in which, first, we should not look forward to punishment for the defeated *peoples*. Secondly, in under-nourished Europe and elsewhere, we should administer relief according to ability to furnish it and to need only, not according to politics or boundaries. Further, we should set up a world organization which will, in principle from the start, and in detail as much as possible, treat victors and vanquished alike. Similarly, if we disarm other nations we must be willing to disarm ourselves, and if we subject any major portion of the world to the control of an international police force, we ourselves should accept a similar control on the same general principles. Again, in regard to curtailment of sovereignty, national governments of powerful peoples, along with those of weak peoples, must discontinue the present policy of determining their own actions in all matters deemed by themselves to lie within the limits of their own sectional interests. All nations alike should be educated for the processes that make for change by the use of peaceful, non-violent techniques. All nations and many classes within nations need, and will continue to need, such education for a long time to come. Finally, Dr. Allee suggests that we should behave towards the defeated peoples from the outset in the way in which Great Britain behaved towards the Boers, and the United States towards the Filipinos, at the turn of the century. Man could, if he chose, focus on his innate drives towards co-operation and attempt to set up a new order based primarily on some such altruistic pattern as this.

The task should be the easier, Dr. Allee considers, because modern biological teaching in these matters resembles many of the social doctrines of the ethical religions, and he urges biologists, as such and as citizens, to try to assist in guiding the existing trend towards a workable world organization along lines which accord with sound biological theory. In such matters the idealist with the long-range view is often the true realist.

The very full study of the problem of Germany which has been issued by the Royal Institute of International Affairs* reaches several conclusions which find support in these views of Dr. Allee. The study is essentially one of the problem of providing for the security of Great Britain in a world in which a dangerously bellicose people like the Germans will continue to exist. It is clear from the start that some compromise between the extremes of force and co-operation must be found: the utter extermination of the Germans or their perpetual enslavement would not be tolerated by the British mind. The Atlantic Charter, in fact, has already committed us to such a compromise, but while the four freedoms are guaranteed to victors and vanquished alike, the vanquished are not to be free to threaten their neighbours again.

A main purpose of the report is to determine at which points of the field each of these two principles of force and co-operation is to prevail. If we are to achieve our purpose, our aims and principles must not be allowed to get in each other's way, and the most valuable part of this study lies in the final section which analyses the prospects of co-operation. This is not to be considered as disparaging to the earlier sections, in which the practical difficulties of disarmament are frankly faced, including the factors which determine the relative strength of Germany and Great Britain which might influence a conflict between the two countries, the possibilities of territorial changes and a new political structure in Europe, the internal government of Germany, economic policy and the control of Germany's war potential. This is a necessary prelude, for the final argument is based on the review of these difficulties and the conclusions, notably that poverty will breed war and that the prevention of German re-armament could be ensured by methods which do not necessarily involve wholesale interference with the capacity of German industry for peace-time production, to which this review leads.

This final section covers much ground that is common to the report on "Education and the United Nations" (see NATURE, August 14, p. 169). Unless the idea of co-operation as a possible and natural state of international relationships lodges in the German mind, displacing the notions of inevitable wars, master and slave races, the rights of the strong and the like, Germany will continue to be a country alongside which it is impossible to live. In rejecting both the extreme views of complete scepticism as to the possibility of changing the German outlook and the over-confidence in the power of education alone to effect great changes, the paper from the Royal Institute of International Affairs is in harmony with Dr. Allee's views. The root of the matter is that a new German outlook, though not impossible, will be necessarily a slow growth, and that, though it can be promoted or retarded by the acts or omissions of foreigners, it must essentially be a spontaneous German development. It will, moreover, be brought about less by precept than by the workings of experience and a new environment.

It is important, therefore, that the policy of the democracies should be such as to favour any genuine attempts by co-operative-minded elements in Germany to establish free institutions. That is one reason why the policy of the Allied Military Government of Occupied Territories (AMGOT) is being watched with such close interest: the other is its importance to the related question of political warfare. While it is impossible at the moment to form any sound idea as to the extent or strength of such co-operative influences in Germany, the Christian Churches may well be found, as this paper suggests, to form a well-tried bridge for an understanding with the West.

Even if the Germans themselves are ready for change, it will not be easy to reciprocate, and on the question of assuming positive responsibility for the whole educational system of Germany the paper is reserved. It lays more stress on the probability of response to American influences, but it recognizes that the German war party will continue to represent Britain as a decadent country. To counter this a vigorous reconstruction policy and programme for Britain, in which social security and educational reform are two essential elements, is important; but it is above all necessary that there should not again be the possibility of Germany attempting to represent defeat in war as victory. The manifest defeat of Germany by force of arms is the first step in the re-education of Germany, even if the lessons of that defeat are not immediately learned.

The real problem here is the time at which vigilant co-operation can be adopted as our policy instead of punishment. However complex may be the reactions of Germany to defeat, we must set ourselves to discover some underlying principle to which the United Nations as well as Germany can subscribe. The four freedoms of President Roosevelt are regarded by this Chatham House paper as providing the most comprehensive and authoritative new definition of a goal of common action. They have the advantage over the Atlantic Charter that they are addressed to the individual and not to the State alone, and are a specific challenge to the German tendency to interpret ideals in a private sense.

Even in good conditions, it will be no easy task to lead the Germans to care greatly for freedom, but that they should do so is the only basis of a tolerable relation with the democratic countries. Freedom they regarded as inefficient, as selfish and as unjust, and offering no convincing object to which faith and idealism could attach themselves. The plunge into Nazism was largely an attempt to escape from these inadequacies and contradictions, and any system which is held out as a possible ground of common international action must meet these needs.

It must first be efficient, and demonstrate that for desirable social ends it knows how to make full use of the scientific and technical possibilities of the new industrial revolution. Secondly, it must be based on an enhanced sense of community, operative not only within but also, in some real sense, outside the frontiers of the State. Thirdly, it must not countenance the maintenance of privilege unconnected with any useful social function. Of one form of this evil the present generation, in Great Britain particularly, is increasingly impatient, and that is educational privilege. Only those educational systems which enable talent, integrity and character, wherever they are to be found, to reach a position of leadership, are in future likely to meet with general approval, and this should not be untrue of Germany. Finally, such a society would be bound to make great calls on the idealism of its members, although it is not within the social order itself that the ultimate springs of moral action arise, and it is ultimately on the ethical view of man as hitherto reflected in the moral attitude of Western civilization that we must depend for the antidote to the dehumanizing influence of efficiency.

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* The Problem of Germany: An Interim Report by a Chatham House Group. (Post-war Problems.) Pp. 92. 2s. 6d. net.

While recognizing that security is important, this Chatham House paper puts the main emphasis on the possibility of pursuing common human purposes which transcend national frontiers. It does not indeed suggest that the State will cease to be the basis of international life or that we need no longer reckon with the factors of political ambitions and aggressiveness. On the contrary, it insists on just such a realistic attitude as Einzig in his "Can We Win the Peace ?"; firmness of purpose is essential, and whatever policy of control or disarmament is adopted towards Germany should be one that will command the unfaltering support of Britain, not for two or three but for twenty or thirty years after the end of the present War. The main lesson drawn from the history of disarmament after the War of 1914–18 is not that technical difficulties in preventing Germany from re-arming are insuperable, but that the real danger-point is a weakening of the Allied will to prevent it.

The two chief points emphasized by the study are that military victory may be expected to create, not a better state of affairs, but an opportunity to create a better state of affairs; and secondly, that those who recognize that international life must be lived co-operatively and more in perpetual adjustment and compromise must be content with short views. They can plan within wide limits their internal policy, but internationally they can do little more than decide the general direction in which they desire to go and do their best to ensure that the first steps lead in that direction. Although it is nowhere explicitly mentioned, the Chatham House group seems, in fact, to contemplate the functional development of international organization on which Prof. D. Mitrany insists in his paper, "A Working Peace System"*, also issued by the Royal Institute of International Affairs. It is pointed out, for example, that acceptance of the principle of 'freedom from want' implies as a general aim that the elementary human needs of food and shelter for all should come to be regarded as a first charge on the world's resources. At a higher level of initiative and adventure, the modern readiness to devise bold schemes of national improvement offers to the workers and technicians concerned the stimulus of conscious participation in a great social purpose. This is a matter of great importance in the German situation, both in regard to the unemployment situation and to the imperative necessity of breaking down and correcting the German quasi-monopoly of the higher technical skills over a large part of Europe.

Dr. Mitrany's argument starts from this need for continuous adjustment and settlement which the League of Nations did not, and could not, meet because its members failed to implement Article 19 of the Covenant, providing for the revision of treaties and other matters which might become dangers to peace, and insists on a pragmatic approach in a period of historical transition. He maintains that in place of providing a formal general framework of co-operation in advance, it is more in keeping with the present trend in emphasis from 'rights' to 'services' to organize international government along the lines of specific ends and needs. The sound method of peaceful change, he urges, is to do internationally what it does nationally: to make changes of frontiers unnecessary by making them meaningless through the continuous development of common activities and interests across them. A different complexion would be put on the problem of security if frontier lines became overlaid with a natural growth of common activities and common administrative agencies. Moreover, functional organization offers some prospect of mitigating the difficulties which arise out of State claims to equality by evolving arrangements which show a measurable and acceptable relation between authority and responsibility, relating authority not to sheer power but to the weight of responsibility carried by the several members.

The experience of the technical committees of the League of Nations as well as that of the International Labour Organisation lends support to this view of Dr. Mitrany, and there are precedents in the European Danube Commission which also encourage the view that specific functional arrangements may well tame the principle of State equality. At least we can find here a further reason why the organizations set up specifically to further our immediate war purposes, such as the Combined Production and Resources Board, and the Combined Raw Materials Board, should not be scrapped immediately the War ends, but utilized to serve post-war needs. In particular, the value of such organizations in post-war relief and reconstruction is apparent, and the draft agreement for the establishment of a United Nations Relief and Rehabilitation Administration and the formation as an outcome of the Conference on Food and Agriculture at Hot Springs of an interim commission to plan a Permanent International Organization for Food and Agriculture, parallel with the International Labour Organisation in scope and open to all belligerents and non-belligerents alike, are definite steps in the direction of functional organization.

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* A Working Peace System: An Argument for the Functional Development of International Organization. (Post-war Problems.) By Prof. D. Mitrany. Pp. 56. 1s. 6d. net.

Discussing the broad lines of functional organization, Dr. Mitrany suggests that public action should only be taken where, when and in so far as the need for common action becomes apparent, and is accepted for the sake of the common good. Only in this way can international organization be well combined with national freedom. Activities should be selected specifically and organized separately, each according to its nature, the conditions under which it has to operate and the needs of the moment. No rigid pattern is required or desirable, and devolution, too, should follow functional lines, functional dimensions determining the appropriate organs.

While each agency could work by itself, the question of wider co-operation must be faced. The co-ordination necessary within the same group of functions, either for technical purposes or for wider functional needs, would be the first stage towards a wide integration. The group concerned with communications illustrates this point. Rail, road and air transport in Europe will obviously require technical co-ordination in such matters as time-tables and connexions, etc., but a wider functional co-ordination will be required to secure the distribution of passenger and freight traffic for the most economic performance. The transition from the co-ordination of several groups of functional agencies to international planning is natural, but overall political authority does not, in Dr. Mitrany's view, appear to be an essential. The general watch over the policies of several joint agencies could well be effected through some such representative body as the Assembly of the League of Nations or the governing body of the International Labour Organisation.

A more fundamental question is that of the structure of the functional controls and the question of representation. Here Dr. Mitrany seizes on the element of professional competence which proved the secret of the success of so many of the League's technical committees, and would make any claim to a share in control depend on a corresponding and evident capacity for performance. On that test smaller States could also qualify, and participants would vary, thus avoiding an exclusive accumulation of influence by a few countries. The same test would govern the extent of the powers of control, and the performance would be practical and measurable, with a periodical balance-sheet, more definite and suitable for examination than the reports to the Mandates Commission, through which the work and policy of each agency could be closely controlled. Dr. Mitrany relies on a personnel which would be largely technical and permanent to develop both a professional pride and a vested interest in good performance, and he adds that not only would the growth of such a service be the best insurance against possible abuses, but also the functional method, by concentrating all attention on a practical public service, is more likely than any other to breed a new conscience in all those concerned with international activities.

Such functional developments will not in themselves create a new system, but, what is much more important, national problems would then appear and be treated for what they are, namely, the local segments of general problems. The system would not be endangered by political or social experiments of one of the participants or even by secession of a member. Authority would derive from the performance of a common task, and be conditioned by it; and while functionalism might lead in time to a federal political system, that would come, if at all, by free organic growth, a natural process of selection and evolution.

The vital questions are, "What are the rightful ends and what are the proper means for achieving those ends ?" Dr. Allee has clearly assisted the formulation of those ends on a basis of scientific as well as social expedience. Dr. Mitrany's powerful plea for functionalism as the means derives important support, as he himself points out, from our present experience with the Combined Raw Materials Board and like agencies, and is also favoured by some of the smaller nations, as Dr. van der Tempel has shown in his recent book ("Keep the Lamps Burning." Hale. 1943. 10*s*. 6*d*.). There can be no doubt as to the value of the organization for relief and reconstruction in Europe in building up a common interest in peace. That may well make a vital contribution in taking certain interests and activities out of the mood of competition and into one of co-operation for the common task. Together these addresses and papers afford impressive evidence that, difficult as is the task before us, it is not insuperable. Given vision, determination and readiness to use the organization, the tools and the technique that lie to our hands, the task of fashioning a world order in which the four freedoms are incorporated and in which Germany herself occupies a fitting place in the European system, may well prove neither so impracticable nor so difficult as victory itself might have appeared when Great Britain stood alone against the Axis Powers in the fateful summer of 1940.

BLUE-PRINTS FOR POST-WAR BRITAIN

Economic Reconstruction

A Study of Post-War Problems. By J. R. Bellerby, assisted by Phyllis Deane, E. Victor Morgan (in Vol. 2), M. Compton and others. Vol. 1: National, Industrial and Regional Planning. Pp. 396. (London: Macmillan and Co., Ltd., 1943.) 21*s*. net.

PROF. BELLERBY is ambitious. In this volume, which is to be followed by a second dealing with international planning, he sets out to provide the blue-prints for a complete system of post-war planning in Great Britain, covering every important aspect of the nation's economic life. Or rather, he presents two different sets of plans, one based on a continuance of private enterprise and the other on a remarkably rapid transition to a nearly complete system of State ownership and collective industrial enterprise. At certain points, notably in the earlier stages, the measures recommended in the alternative plans are largely the same; but the divergence increases very fast after the initial measures designed to deal with the immediate emergency following on the cessation of hostilities. In both plans, it is taken for granted that there must be a profound departure from pre-war policies and assumptions, and that the State must, in one way or another, take the full responsibility for maintaining employment at a satisfactory level, and therewith for raising effective consuming power in steady correspondence with the expansion of the power to produce. It follows that Prof. Bellerby's system of private enterprise involves a very large element of public control, including the effective control not only of the volume of investment, but also of prices (including wages), interest rates and monetary conditions generally, and also the establishment of an assured minimum level of consuming power. In effect, the main difference between the two plans is that in one the State is to undertake directly the conduct of the main industries in accordance with its own co-ordinating economic plan, whereas in the other the execution of the plan, and even a large share in its making, are to be delegated to special organs representative of industry itself.

It is somewhat unfortunate that Prof. Bellerby makes, without anywhere so far as I can see clearly arguing, the assumption that Great Britain will have to choose between these two plans absolutely, and cannot either choose a cross between them, or something different from either. There are, he says, only two economic systems—private enterprise and State enterprise; and between these an absolute choice will have to be made. He says categorically, "From the point of view of planning, a partial change will avail little. The effective choice is between the system of Private Enterprise on the one hand and complete State-ownership on the other." True, later on one discovers that he does not really mean quite this; for he proposes, for some time at any rate, to retain a considerable private sector within the system of State-ownership. But the general scheme of his book is based on the idea of this absolute choice between two systems; and this is where I find his treatment exceedingly unrealistic. For, even if there are in the last resort only two alternative systems (and where, in such a categorization, do such things as the co-operative movement or the London Passenger Transport Board fit in ?), these two systems have many variants, and to say that we must choose between them is not the same thing as saying that we must choose between the particular versions of them presented by Prof. Bellerby. For example, if we choose private enterprise, are we really compelled to have as its accompaniment his peculiar plan for an all-party parliamentary planning conference working side by side with an industrial and economic parliament consisting mainly of employers' and workers' representatives in equal numbers ? Are we compelled to accept his plan for a price-fixing board which is to have complete final control over wages in all industries, as well as over prices ? Or, if we opt for State-ownership, must we really take over 75 per cent of the national productive activity of the country in a few gigantic swallows spread over but a very few years ?

This is surely a false dilemma. It may be true that we shall have to make up our minds whether we wish the driving force in post-war economic policy to be socialistic or capitalistic, and to get ourselves a Government in accordance with our general preference. But it does not at all follow that the Government we get must pursue a 100 per cent policy of either Socialism or Capitalism. If Prof. Bellerby were contemplating the possibility of a socialist system applied as the outcome of a revolution *à la Russe*, one horn of his dilemma might exist; but he explicitly excludes such a situation from his subject, and assumes a post-war economic order that is to be built up by constitutional means. The result is that he is apt to impale himself on the horns of his own unusual dilemma. It is nonsense to suggest that a plan could not work at all unless it had precisely the composition postulated for one or other of his two alternatives.

It is a pity that Prof. Bellerby has marred the shape of his book in this way; for there is in it a great deal that is good. He is much more prepared than I am to trust representative bodies of employers and workers to make plans which will be free from restrictive taint and will be constructed solely with a view to the common benefit of the people; and he seems to me to be unrealistic in his handling of the extremely complex and difficult problem of price-control, and still more in his proposal to make wage-control a secondary function of his price-controlling body. As against this, there is much that is excellent in his discussion of State planning policies and methods, in his account of the problems and prospects of each of the leading industries, and in his attempt to distinguish between the probable stages of economic emergence from war to peace. His discussion of these matters involves too much detail to lend itself to summary; and it is to be hoped that what I have said earlier by way of criticism will not deter any reader from studying it.

The fundamental problem of economic planning, as Prof. Bellerby envisages it, is the maintenance of an adequate level of consuming power. He accepts completely the view that the radical disease of capitalism in the pre-war world was its tendency to generate crises of under-consumption. Indeed, he states this position in terms that are a great deal nearer Hobson than Keynes, and lays proportionately large stress on measures for the maintenance and increase of consuming power, both temporarily in the emergencies that may be expected to arise during the successive phases of reconstruction, and also permanently. He wants, as immediate post-war measures designed to be permanent, both family allowances and a guaranteed minimum standard of income : he lays stress on the beneficent effects to be looked for from the repayment, at the right times, of service gratuities, post-war credits, refunds of excess profits tax, and so on. But he goes further than this, and contemplates the actual creation of purchasing power by way of all-round gifts to consumers as one of the means that it may be desirable to use in combating post-war depression. I am glad to see that, in connexion with these proposals, he recognizes the imperative necessity of avoiding, during the critical period of reconstruction, any binding stabilization of the pound in relation to gold or the dollar, though he does appear to contemplate that such stabilization may come later, as the accompaniment of an agreement to follow common expansionist policies in the conduct of economic affairs.

In general, Prof. Bellerby has written an interesting, and often suggestive, book, but has written it on a bad plan. Some of his dogmatism is due to the attempt to crowd in too much and to cover more ground than one man can cover in one book, however richly he may be endowed with research assistants. But some of it is due to a mistaken striving after clarity, in face of possibilities so varying that he is tempted to exclude most of them, and to choose just those which fit in best with his general plan. He is at his worst when he is discussing his second alternative—State-ownership; further, he makes all sorts of unwarrantable assumptions about the way in which industries would have to be nationalized, and the forms which compensation (or the absence of it) would necessarily take. His discussion of private enterprise is much better, because there he is dealing with something that exists, and has to begin by taking it as it is, and not by constructing an unrealistic model and then treating it as if it were the only possible variant. If this review is less favourable than the book deserves, it is because this state of unrealistic formalism in its author has annoyed me, and caused me to do less than justice to the particular things he has done well.

G. D. H. COLE.

WEED CONTROL

Weed Control

A Textbook and Manual. By Prof. Wilfred W. Robbins, Prof. Alden S. Crafts and Richard N. Raynor. (McGraw-Hill Publications in the Agricultural Sciences.) Pp. xi+543. (New York and London: McGraw-Hill Book Co., Inc., 1942.) 35*s*.

THE problem of weeds and their control or eradication is one which increases in importance with modern advances in agricultural practice. On land giving low returns, due to poor quality of the soil, poor cultivation or other factors, it may be uneconomic to adopt any intensive methods of weed control. On well-cultivated land, in good heart, and bearing heavy crops, it is justifiable and often profitable to expend considerable time and money in combating weeds in order to bring the reduction of crop due to competition to the lowest possible level. Much experimental work has been done and much written on the subject, and Messrs. Robbins, Crafts and Raynor have rendered a great service by gathering into one volume a comprehensive survey of this field of activity.

The rapidity with which weeds spread from one area to another emphasizes the need for a primary method of control, involving rigid inspection of imported seeds and prompt dealing with initial infestations of bad weeds. The worst pests in many countries, such as blackberry, Russian thistle, creeping thistle and morning glory owe their unenviable position to neglect of this elementary precaution. Furthermore, changes in methods of cultivation may cause native species to behave as weeds.

The harm caused by weeds is due not only to their demands upon the limited amounts of food and water available in the soil, the water requirements of bad weeds often being greater than that of the crops. Heavy expenses and monetary loss also are involved in control and eradication, in seed cleaning, clearing ditches and in the reduction of the market value of crops. The quality of milk, grain, hair and wool is often reduced, and certain weeds also act as alternative hosts for various crop pests.

Control and eradication need to be distinguished, as the latter is seldom economically possible, except in such cases as dodder. The life-history of weeds is closely related to effective methods of control, and for large-scale work very special methods have been evolved, as flooding by water, heat treatment by flame throwers and steam boxes, and paper mulch in areas of very rapid growth. There is, however, no universal panacea for killing weeds, and, to quote the authors, "general recommendations must be interpreted in the light of the specific situation, amended to meet the requirements imposed and tempered with judgment based on local experience".

On arable land the time-honoured method of weed control by careful cultivation is still often the most economical procedure, but great strides have recently been made with chemical agents. These may act in various ways: as herbicides killing by contact with the leaves or by being translocated through the plant tissues, or as soil sterilizers preventing the growth of plants over varying periods of time. Some chemicals, as sodium arsenite, are non-selective and kill all vegetation by contact; others are selective, killing weeds but sparing crops of certain types, as occurs with charlock among cereals. This group of weed killers includes highly soluble fertilizers and toxic compounds which are reduced in toxicity by contact with soil.

Translocated sprays, the physiological action of which is discussed, pass downwards through the tissues, killing as they go. Arsenical sprays and sodium chlorate fall into this group. The same weed killer can be used in various ways, according to the rate of application and the environmental and soil conditions.

Detailed accounts are given of the more important weed killers with full reference to the work of many investigators, a bibliography being appended to each chapter. For convenience of reference these authors are gathered into a general index, though this does not appear to be complete, as such an important investigator as Korsmo fails to appear therein, although adequate reference is made to his work in the text.

Weed control on special areas as railroads, paths, etc., is effected by soil sterilants, among which sodium arsenite stands almost alone as regards permanence. All others are more or less temporary in nature, the type of soil and environmental conditions affecting their action considerably.

Weed control by chemical means entails of necessity special machinery, much of which is effectively illustrated. Consideration is also given to various special problems, as the weeds on grassland and on uncropped areas, control of dodder, and stump- and tree-killing, the latter sometimes being dealt with by injection of poison. Certain weeds receive special attention; for hoary cress, morning glory, sheep sorrel, Russian thistle, and puncture vine, among others, are so dominant where they occur that they constitute major problems. In the appendix various useful tables and lists are given, including an estimate of the number of seeds produced by various weeds, and examples of native species in various areas which have now usurped the role of weeds.

The authors are to be congratulated on producing a book which will be of great value to all who deal with the land, and which should stimulate experimental research on practical and economic methods of weed control.

WINIFRED E. BRENCHLEY.

RACE, CLASS AND MATING IN THE EVOLUTION OF MAN*

By DR. C. D. DARLINGTON, F.R.S.

The Background

QUESTIONS of race in man have been the subject of increasing dispute for the last hundred years. Most of the positive opinions that have been advanced owe little to our recent knowledge of heredity, but they show the background on which we have to work in applying this knowledge. Our starting point has to be the primitive or Old Testament view. It was expressed by Archbishop Trench when he gave the opinion that the savage "is a dead withered leaf, torn violently away from the great trunk of humanity, and with no more power to produce anything nobler than himself out of himself, than that dead withered leaf to unfold itself into the oak of the forest"[1]. On the other side Darwin opposes to this pessimism the more hopeful view that "all the races of man . . . are descended from a single primitive stock" and have come to differ in heredity during a continuing process of improvement[2].

These opinions differ in the direction of change, backwards or forwards, but they agree that there has been change. Powerful hereditary differences both in mind and body distinguish the races of man. A third view, which springs from the New Testament and also owes something to Rousseau and Marx, emphasizes, both for race and class, the importance of differences in the environment rather than in heredity. Such a cleavage of ideas as to the genetic evaluation of human races is assisted by the facts recognized by Darwin. "If we reflect on the weighty arguments," he writes, "for raising the races of man to the dignity of species and the insuperable difficulties on the other side, in defining them, the term 'sub-species' might here be used with much propriety. But from long habit the term 'race' will perhaps always be employed"[2].

To-day the "weighty arguments" and the "insuperable difficulties" are still at war. On one side stand those who, following Gobineau, assert that modern peoples spring from hypothetical pure races, from one of which, happily superior to the rest, they themselves are descended without contamination. Further, they hold that races described as Nordic and Mediterranean, and even their mixtures, can be recognized by the forms and features of individuals[3]. Even, by a further stretch of theory, they take language as an independent and sufficient criterion of race, and it is from this simple view that the "ethnographical" maps which appear in our atlases take their title. At the same time, on the other side are those who say that every population "includes many types and their various combinations" and therefore "the word *race* should be banished, and the descriptive and non-committal term *ethnic group* should be substituted"[4]; and further, "the so-called racial explanation of differences in human performance and achievement is either an ineptitude or a fraud"[5]. Again, by a stretch of this theory, it is held that primitive peoples can, by prolonged subjection to the benefits of European rule, be brought to develop a culture comparable with our own, when they will be, as it is said, ripe for self-government.

Both these lines of argument are now being politically applied. It is therefore worth our while to try to form an opinion of their scientific value. Such an opinion can, I believe, be reached on the basis of the postulates, and on the analogy of the conclusions, of experimental genetics.

Mating Systems

We must begin, following the example of Darwin, with something we understand better than man. namely, the breeds and races of domesticated plants and animals. If a plant is regularly self-fertilized—a rare condition—we can agree that all the descendants of one plant, or of a group of indistinguishable plants, will, as a rule, conveniently constitute a race or variety. Even so, if they are divided into groups that undergo mutations and are differently selected, the groups will become separable, and sometimes are separated, as distinct races.

When we turn to cross-fertilized plants and animals we find quite another state of things. It is now a question, not of one parent, but of the group from which any individual may take its two parents, and from which all individuals will later take their ancestors. The mating group and the group of common ancestors are the same type of unit. In no such group will all the individuals be alike, and they may be highly diverse. To what then does the group owe any unitary character it may possess ? It owes its character to what we may call its chromosome pool. It is a property of germ-cell formation that half the chromosomes of the parent are rejected in the formation of each germ-cell. In a stable population therefore, where two parents have two offspring, one quarter of their chromosomes are lost to the chromosome pool in the next generation and one quarter are doubled in frequency; only a half reappear once. By mere chance the pool suffers regrouping and by mere chance two separate pools will be differently changed, and, if they are small, rapidly changed[6].

There is something more than chance, however, at work. Different groups are inevitably differentiated by selection whether natural or artificial. The original and subsisting function of sexual reproduction is to expose to selection all the gene-combinations it can produce at every level of their activity and in the greatest possible range of environments. The conditions of survival and reproduction of the individuals produced by the recombinations of genes and chromosomes are different in different countries, climates and ways of life. Selection is continually changing the character of the chromosome pool by differences of survival and of fertility. Every couple will not have two offspring; and most of the genes concerned are individually invisible in their effects. Furthermore, selection is throwing away, not only unsuitable genes, but also unsuitable combinations of genes, and so balancing the genes contained in the chromosomes against all the others with which recombination from the pool brings them into relationship. This internal selection is producing what Mather calls a "relational balance" which is characteristic of the particular mating group[7]. Thus at three levels, the environmental, the genetic, and the jointly genetic and environmental, cultural, level any mating group has a unified selective response which differentiates it from all others.

With two inbred groups, the cross-breeding of which is prevented, the point at which we shall begin to refer to them as races is then a question of *ad hoc* convenience. We can merely say that that point will be reached more quickly if the groups are smaller; if the original differences between them, and the heterogeneity within them, are greater; if their mutation-rates are higher; if their selection is more rigorous or more divergent.

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* Substance of an address given to the Association of Scientific Workers in Cambridge on July 16.

In our domesticated races we are accustomed to use as our index of pure-breeding certain clear genetic differences, the 'points' of the breed. These are determined by major or 'marker' genes. We cannot attend so strictly to the minor or 'polygenes'. Artificial cross-fertilized breeds are therefore always more heterogeneous than they seem. Marker genes are also used by the classifiers of wild plants and animals. They are not, however, the most important agents in separating natural groups in animals or man. This is recognized by the use of geographical and historical criteria in addition to morphological ones. We now know that natural groups have often become intersterile without any difference having been noticed by the morphologist; and if invisible polygenic differences separate races their internal homogeneity due to their inbreeding must also be invisible. Natural races are, therefore, more homogeneous internally than they seem, by comparison with artificial breeds. Thus convergence as well as divergence is partly cryptic, and so far as it is cryptic its only measure, apart from experiment, is the breeding history of the group.

Group Limitation in Man

It is our business to find out how this group effect has worked in the history of mankind. Man is derived from a group, at the beginning of his independent history, of ten, or perhaps a hundred, thousand ancestors. These common ancestors were genetically diverse, perhaps as diverse as any living men. Their progeny have continually expanded in numbers, and these numbers alone have set the *genetical* limit to the inter-breeding group in man. Within this expanding population, however, there have been *physical* limits to the effective breeding groups and these have not always expanded. Mobility has depended on geography and on civilization, either of which may help or hinder it. Navigation helps, agriculture hinders. Finally, there have been *social* limits to the mating groups which restrict the choice of mate to a fraction of those who are physically accessible. They depend on man's intellectual discrimination, which itself has developed with his cultural evolution. They have, therefore, been applied with increasing rigour as the density of human population has increased; and, though cultural in origin, in effect they are always genetic as well, since culturally separated communities must always become genetically distinct.

When the cultural barrier arises from the physical limitation we have the characteristic origin of race. When it arises from a social differentiation we have the origin of class. When the two are combined and stabilized we get the formal climax of caste in India.

How large in effect are the mating groups into which man is divided? Keith[8] has surveyed the action of 'tribal instincts' in restricting their size in primitive peoples. The invisible divisions of civilization can be measured in other ways. One is from the frequencies of the blood group genes[9,10]. The distinctness of Jewish and Gipsy minorities from the neighbouring majorities shows the strictness of their previous inbreeding. Prof. Fisher tells me that, in rural Ulster, groups with English and Scottish surnames still remain distinct; with a minor religious distinction scarcely any intermixture has occurred during ten generations. Church records of Ulster communities in North Carolina show that the same endogamous habits have been carried across the Atlantic[11]. In the same way the frequency of conditions due to recessive genes can be used to establish the separation of groups. If deaf mutes are 4½ times as frequent among Jews as among Gentiles in Berlin, the two groups must be effectively separate breeding units[12].

Again, Dahlberg has inferred the average size of the group among which mates are chosen from the frequency of cousin marriage[13]. This frequency has changed in Bavaria, for example, as though the size of the group had increased during the last fifty years from 2,000 to 5,000. Increased mobility has been breaking up the agricultural breeding system.

Other methods of measuring the mating system and its effects, using the frequency of X-chromosome genes and of heterozygotes, will doubtless be used in the future[12,13,14]. But we can already infer in these different ways that the mating group among civilized peoples, although less stable, is not always larger than among primitive peoples and is smaller than is usually believed by the individuals concerned.

Adaptation of Classes

A part of the subdivision of a race into smaller mating groups is inherently adaptive. The closer social intercourse within groups following the same trade favours the mating of similarly adapted individuals. This effect is reinforced by assortative mating. As Pearson found, there is correlation between the heights of husbands and wives. Like mates with like. All over the world, not only in India, fishermen, cotton-workers, coal-miners and peasants are inbred groups. Moreover, groups lose those individuals who are least suited to them. Thus selection will exaggerate itself. First a man selects his mode of life and then his mode of life selects him. The saying that it takes three generations to make a cotton spinner may well reflect this process. Nor can we doubt the advantage that has come to the world from the assortative mating of musicians. These are processes which will continue to be refined by each new development of human culture so long as individuals are free to choose their mates.

In monogamous societies based on hereditary wealth, economic differences cut across adaptive differences and establish a still finer subdivision of mating groups. This effect will always be strongest in the layers constituting the governing class. This class is of paramount importance in determining the real and apparent 'national character' and hence in controlling racial evolution. In its origin, like other groups, a governing class must in a sense be adaptive, that is to say, selected for its capacity to govern under the conditions prevailing at the time. Is it capable of maintaining its adaptability? The answer is that there are two main conditions operating to prevent it doing so.

The first is that groups within it are not highly inbred and specialized for their function. Among eminent churchmen (the most inbred profession in England) for the last fifty years only 25 per cent have been sons of churchmen, and the proportion who have married the daughters of churchmen is now even lower than that ("Who's Who", 1890–1940). From the mixture that is going on, segregation of unsuitable types is therefore likely to be more frequent than in the working classes. But the inheritance of wealth (or power) gives a governing class the means, which it is bound to use, of releasing itself from selection pressure, of preventing its members taking their adaptive level. This effect is partly a cultural effect of family life, but it can be assisted by the development of such special educational barriers between classes as we find in England.

The second condition lies in the mechanism of social diffusion by which governing classes may be reinforced and their deterioration avoided. On one hand, diffusion between classes may be prevented. Then, not only are human individuals wasted but also genetic materials, useful to the race, are apt to be thrown away, since they are tested in the wrong environment. For a while, of course, such materials may accumulate until changes such as the English, French, or Russian Revolutions occur to make use of them. If, however, they are to be stored, as in India, for thirty or forty generations, these elements will be lost before they can be used. The social tension will be released and the system internally stabilized. The economic and professional castes of India temporarily broken by Buddhism and loosened by the Mohammedan invasion have been given by British rule an organic rigidity to which every process of ordered government, even the Census, contributes a stabilizing effect[15].

On the other hand, where social promotion occurs, at first sight it might appear that social merit must always be its chief agent. But just as a governing class in its origin is always mixed, so it will be in its reinforcement. To this process Fisher[16] ascribes the decay of governing classes and in turn the decay of the empires they govern. He suggests that social promotion of men is favoured by the reduced fertility of their parents, which has been shown to be heritable. This effect will be all the more important for exaggerating itself. But it is only a part of the story. The social promotion of women will always be based on qualities of a different kind from those favoured in the promotion of men and often conflicting with them. Its effect will be predominant where the governing class is legitimately polygamous. We may, therefore, see in the excessive fertility of sultans and emirs a process contributing to the rapid decay of Islamic cultures.

Thus class division combined with diffusion are necessary for the efficient utilization of the race where the differentiation of the culture is stable; but the conditions of diffusion, unless suitably controlled, may make it little better than no diffusion at all.

Conflict of Systems

If mankind had long been broken up into genetically isolated fragments it would at once be obvious to us that race made culture and language. Any group, however heterogeneous, would have to be held genetically responsible for its aggregate cultural activities. Now both races and culture are continually being mixed, but culture is a more important obstacle to this mixing than race. Hence the relationship becomes reciprocal. Culture and language often make race just as much as race makes culture and language. It is this argument, combining genetic premises with a dialectical change, which has hitherto defeated historians and philosophers.

When languages are mixed or transferred the process is always selective. In Burma social advancement is often the incentive and tribes "change their language almost as often as they change their clothes"[15]. The same principle applies in the West. Owing to the dominant cultural influences of certain Western languages, English, French, German, Spanish, Swedish, Russian, Turkish, Persian, minor language and dialect groups have at various times become socially and culturally depressed. Where the depressed group has held on to its language in spite of this, it has by social diffusion lost genetically useful elements to the dominant group. In recent times we have seen the resurrection of such depressed and genetically extracted classes as nations, and the artificial result has sometimes been disappointing. A similar genetical extraction and depression has commonly benefited the town at the expense of the country and the capital at the expense of the provinces. Again, where a caste system is fixed, as in India, this extraction is prevented to the common disadvantage.

When conquest breaks down a mating barrier, and races fuse, outbreeding momentarily succeeds inbreeding with results which historians again have found hard to explain. The most instructive of these changes is that accompanying the expansion of Islam, for here the same experiment was repeated, extending in time over a thousand years, and in place from Marakesh to Delhi. The choice Islam offered to the vanquished with varying emphasis was a simple one: exogamy or death. The result was nearly always the same. New genetic combinations were able to take advantage of new cultural combinations and a striking cultural development took place, although limited for the reasons we saw to seven or eight generations. This effect was due to the breakdown of class as well as race barriers assisted by polygamy. The conversion to Christianity, on the other hand, had no such striking cultural consequences, because it did not destroy the existing mating barriers established by class or by race.

Polygamy thus affects both class structure and sexual selection; and sexual selection is biased by changing social conditions. The two sexes must always be complementary in reproductive function but otherwise their adaptations are, genetically at least, as different as those of two closely related species. Karl Pearson[17] showed how the average cranial capacity of different races differed and how the proportions of male to female also differed. His summary led him to the conclusion that in the older civilizations which were closer to a matriarchal stage of development, women's cranial capacity was relatively larger than in modern civilizations. Whether or not this inference is sound we cannot help assuming that human history has been a process of intellectual specialization of the two sexes which for the reasons we have seen will have led to different results in different races and classes.

The historic change from matrilinear to patrilinear inheritance has also led to important conflicts. In all groups of mankind exogamy rules have probably existed at one time. Marriage has been forbidden within certain degrees of relationship, real or imaginary. The system has reached its highest development in the sparsest and therefore most inbred communities, as in Australia[18,19].

The exogamy rules often break down. They do so especially when the inheritance of property develops during an unresolved conflict between matrilinear and patrilinear inheritance. The result is an instructive experiment. In the Ptolemies, successful incest began after a half-cousin marriage. In the whole line of thirteen, eight had full brother-sister marriages, but only three were fruitful. No two of these were in successive generations. The legitimate inbred line died out and Cleopatra's mother is unknown[20]. Similarly in Peru only one of the royal Incas is known to have been the issue of a brother-sister marriage. In neither case was there any continuous incest[21].

Successful and regular incest, on the other hand, has frequently been maintained by half-sister marriage, for example, in the Eighteenth Dynasty in Egypt[20]. Such marriage was common also in ancient Athens and among the Mongols and it occurred in Ur and in the royal house of Siam. The practice is no doubt helped by half-sisters being very numerous and also by the action of the matrilinear incest taboo. The evidence of experimental breeding in turn makes sense of this taboo. Only in five generations of self-fertilization and in ten of brother-sister mating will sterility usually wipe out the inbred stock. The effect will be most drastic when inbreeding is suddenly introduced in an outbred stock, and the inbreeding must be continuous to be cumulative. The exogamy rules of man like most moral laws seem, therefore, to have been derived by an extreme extrapolation. Incest is directly dangerous to the progeny only under special conditions which have nothing to do with those governing the indirect effects of inbreeding on a whole group.

The group effect of inbreeding is that it gives homogeneity, predictability of offspring from parent, rapid adaptation, easy transmission of culture, sometimes too easy, and hence potential stability of culture. It is a conservative agent and it conserves itself best in the most conservative peasant communities. It opposes initiative. It reduces conflict, sometimes disastrously. If applied to specialized classes it conserves their differences and increases their fitness. In India the endogamous caste system has preserved a store of variation which, if released by free crossing or recombination, might well enable us to reconstruct the whole genetic range of mankind.

On the other hand, inbreeding, while increasing temporary fitness, reduces flexibility. It reduces the means of acquiring fitness to new conditions. The Andaman Islanders steadily decreased in number from 4,800 in 1858 to 460 in 1931[15]. This is said to be due to the deleterious effect, either of inbreeding, or of the contact of civilization with a primitive people. It would be more accurate to say that it was due to a homogeneous race being confronted with conditions to which it was not adapted. Homogeneity provides the optimum condition for epidemic. Heterogeneity permits selective survival and recovery.

This advantage of heterogeneity merely shows in a special way how inbreeding frustrates the long-term function of sexual reproduction, the recombination of genetic differences, recombination which cannot take effect without the combination of these differences by outbreeding.

The long-term function of outbreeding has moreover come to imply a short-term advantage. Species become adapted to outbreeding and the adaptation, as we saw in regard to incest, cannot be overridden without risk. This adaptation has been explained in general polygenic terms by Mather[7]. His explanation is all the easier to apply owing to the probable importance of super-genic differences arising through inversions of groups of genes. These are more likely to favour the heterozygote than are single gene systems since they cannot be broken up by recombination in the heterozygote. The equilibria of blood group and taste genes which seem to have persisted in man since before his separation from the apes[22] suggest such a favouring of heterozygotes.

Hybrid vigour might be expected to be shown in these circumstances. Dahlberg[23] attributes the increase of average height of recruits in Sweden by 9 cm. to the increased outbreeding following increased mobility. The change is steady over a hundred years and cannot, therefore, be due entirely to improved nutrition. We are accustomed to regard such a change, which is noticeable also in England, as advantageous, and that may be so. But if the previous range of heights was an optimum, secured by adaptation to conditions which have not changed, we must now be too tall. Thus there is a conflict between the advantages and the disadvantages of outbreeding at both genotypic and phenotypic levels and as between the short view and the long one.

How then is this conflict to be resolved? In general the combination of inbreeding and outbreeding in parallel rather than in sequence gives the greatest efficiency in the utilization and selection of the available variation of mankind and, consequently, the most rapid evolution. A subdivision of mankind into races and classes is, therefore, highly advantageous provided that we can assure its instability. This seems to be no insuperable difficulty at present. The rapidity of differential population changes, the increase of mobility, the changes of methods of production, and the technical requirements of government, have upset the stability of races and classes as well as the adaptation which partly justified that stability. In these circumstances the 'young' peoples newly derived from a mixing of races or of classes have obvious advantages over the most permeable of stable societies yet known. Outbreeding for the moment is in the ascendant because cultural evolution is increasing its pace; and this again is a reciprocal and therefore self-exaggerating effect.

Conclusion

Man's intellectual and cultural evolution has led not to an absence of the races found in other species but merely to a special character in these races, due we may say to a special combination of artificial and natural selection. He uses a cultural and intellectual discrimination in the subdivision of his mating groups which must artificially accelerate his evolution. His habits of migration and conquest, on the other hand, continually constitute new groups of hybrid origin. These must therefore be, for most of their lives, groups, not of decreasing, but of increasing homogeneity. The common posterity, rather than the common ancestry, is what matters in human races and classes. Moreover, these groups are not classified by marker genes. For all these reasons human races and classes are more homogeneous than they seem; animal breeds, by contrast, less so.

We must, therefore, regard those who would have us shut our eyes to the genetic differences between races and classes, lest the recognition of unlikeness should generate antagonism, as offering us the counsel of timidity and escape. Let us rather consider that all the races and classes of men, however distinct, and usefully distinct, are likely in the end to have their posterity in common and to the common advantage; and that this posterity will still be classified and subdivided. Meanwhile, let us use the methods at our disposal for evaluating the different genetical and cultural prospects of different races and classes and systems of mating. In doing so we shall recognize the reciprocal connexions that exist between changes in the mating system, the economic system and the political system. For in changing one we are likely to change all three, and the systems which are functionally the most advantageous have a prospect of being eugenically the most desirable.

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A MIOCENE ANTHROPOID MANDIBLE FROM RUSINGA, KENYA

By DR. L. S. B. LEAKEY
Coryndon Museum, Nairobi

IN September 1942, during a brief period of leave from my war-time duties, I was able to revisit the Miocene fossil beds on Rusinga Island in the entrance to the Kavirondo Gulf of Lake Victoria. During my stay on the island, I had the good fortune to discover a nearly complete anthropoid mandible *in situ*. This was removed in its matrix to the Coryndon Museum, Nairobi, and there developed.

The Rusinga Miocene fossil beds were studied by my third East African Archæological Expedition in 1931–32, and again in my fourth expedition in 1934–35. On both occasions collections of fossils were made which included anthropoid material, and on the second occasion, in 1935, the expedition geologist, Dr. P. E. Kent, made a special study of the fossil beds from the stratigraphical point of view, and of their relation to other Miocene beds in Kenya.

The new mandible now discovered in these Rusinga Miocene beds is by far the most complete anthropoid specimen yet found in Kenya, and is of special importance. It has the whole of the symphyseal area preserved intact as well as the left condyle and coronoid. A detailed study of the above specimen as well as many other less complete Miocene anthropoid fossils from Kenya has now been prepared by Dr. McInnes[1]. The object of the present communication is to give a preliminary account of certain features of the new fossil, so as to enable those who are interested to order reprints of the more detailed paper.

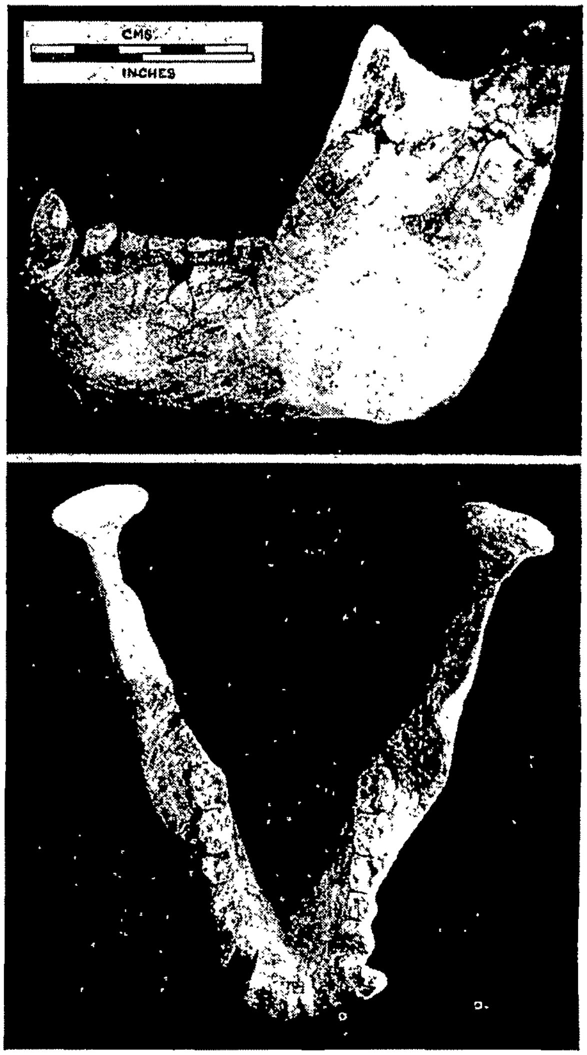
The characters which appear to be of special importance are:

(1) There is no simian shelf such as is seen in modern apes and also in Dryopithecus. The most backward point of the symphysis is in the region of the genial tubercles as in man. From this point the symphysis bends forward again much as in man, instead of having a backward projection from a genial pit as in the great apes.

(2) The premolars are much reduced in size.

(3) The first and second molars are wider posteriorly (distally) than anteriorly (proximally). This feature is associated with a shortening of the molar premolar series, indicative of a reduction of the muzzle-length and probably a more vertical face than in living great apes.

(4) The ascending ramus is relatively high and



MIOCENE ANTHROPOID MANDIBLE FROM KENYA.

wide compared with the size of the corpus and the area of the chewing surface.

(5) The molar-premolar series are remarkably convergent anteriorly as in man, and not parallel or convergent posteriorly as is usual in the great apes.

(6) The form of the condylar process approximates more to that seen in man than to that in the living apes. Unfortunately, this part of the mandible is unknown in any other fossil ape.

(7) Viewed from the front, the mandible has a certain general resemblance to the human form.

(8) The flat wear of the molars is reminiscent of that seen in Eoanthropus and man rather than the type of wear seen in the great apes. On the other hand, the canine is large. The third molar exhibits the typical Dryopithecus pattern of the cusps, and the premolars, though reduced in size, are more anthropoid than human in character.

This new mandible is assigned to the genus Proconsul originally described by Dr. A. T. Hopwood from fragmentary material from Koru, Kenya, but it does not seem to bear out his interpretation that "the genus is ancestral to the chimpanzee", but rather supports and gives added point to the view expressed by Drs. Gregory and Hellman, that Proconsul stands "near to the common ape-man stem".

I would like to express my thanks for the comments sent to me by Sir Arthur Keith, Prof. Le Gros Clark and Dr. W. K. Gregory as a result of notes and photographs sent to them soon after the discovery was made.

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CONFERENCE ON THE FUTURE OF ARCHÆOLOGY

By KATHLEEN M. KENYON

Acting Director, Institute of Archæology, University of London

AT the present time, the thoughts of many people are turning to the problems of the post-war period. Many of these problems are material and in the economic sphere, but equally important are those in the cultural and educational sphere. Some archæologists have been considering in what way and by what means archæology is going to make its contribution to the post-war period, and during August 6–8 a conference on the Future of Archæology was held at the Institute of Archæology of the University of London, at which some 280 people were present, including most of the leading archæologists at present in the country.

The dominant theme was that archæology, as Mr. W. J. Varley expressed it, was no longer the pursuit of a very recondite erudition by a select few in a quiet temple dedicated to no other purpose. It was a study which could clothe the past with reality, through which man can achieve what is essential if he is to survive, a sense of community with all other men in the world of space. Dr. Grahame Clark, who opened the conference with a paper on the "Contribution of Archæology to the Post-War World", put the claim of archæology to be of value to everyone, in his statement that it not only gave to old and young alike an understanding of the birth and growth of culture in their own lands, but it also provided a basis of common understanding between men of all nations, since the early history of mankind in the Palæolithic period, for example, formed a common heritage of all men.

Prof. V. G. Childe, in a stimulating paper on the "Unity of Archæology", stressed again this same point. The different branches of archæology had grown up by varied means. Classical archæology, due to its antiquarian ancestry, had developed from a search for monuments, coins and inscriptions. Mesopotamian archæology was originally interested almost entirely in tablets and sculptures, while prehistoric archæology, owing to the lack in this sphere of more spectacular relics, was compelled to devote attention to everyday objects, and the way of life of the common man. Gradually, however, all branches were coalescing and making as their common aim that of recovering and reviving the life of societies of the past from their concrete remains, and to do this all branches were borrowing methods from the others. A unity of approach was highly important, since archæology alone can tell how and in what directions humankind has progressed. Written history is too brief, and only archæology can survey men and their achievements over half a million years in every corner of the globe.

The problem next in importance to be discussed was how archæology, granted thus to be important to all, could be placed before the public in an interesting and palatable form. In a session devoted to "Archæology and Education", the different ways that the subject could be introduced into elementary, secondary, university and adult education were discussed, and the matter came in again in the session on "Museums and the Public". Archæology, through reconstruction and visible remains, can make local history live both to children and adults, and the child who could see actual Roman leather shoes, and the British workman who could carry through voluntarily an arduous excavation in order to see what sort of a job his Iron Age ancestor had made of digging a rock-cut ditch, were gaining something which no amount of lessons or lectures could give. Many illustrations were given of the widespread interest there is in the concrete history of the past. To meet this, archæologists must be prepared to popularize their science. All teachers of history, geography and art should have a grounding in archæology, and something should also be done to bring home to men of science that life is not all atoms and formulæ, but that some kind of historical knowledge or understanding is essential to make them educated men and women.

Other sessions were devoted to the actual problems, both archæological and of organization, of the future. Speakers outlined the problems needing attention in the different fields. Both Britain and the Near and Middle East were covered by a number of papers, and detailed suggestions of needs for the different countries were made, while during the discussions, emphasis was laid on the fact that areas such as Central Asia, the Far East and South America should not be neglected. A very special problem was set by the opportunities given by war damage for the examination, before reconstruction, of sites both in Britain and the Mediterranean area, and adequate provision for this must be made. The need for planning was continually referred to, but Mr. J. N. L. Myres made the very important point that planning must be elastic and must neither curb individual initiative nor regiment research.

In all the addresses there kept recurring the view that, in the conditions to be expected in the post-war period, archæology would be financially in a difficult position. Though some speakers felt that security was undesirable, and that archæologists were the more devoted from having to stump the country raising funds, as did Sir Flinders Petrie, the general consensus of opinion was that unless some reasonable prospect of a livelihood was held out many promising students would be lost. The growing difficulties of archæological societies were pointed out by both Prof. Alan Gardiner in his comparison of the palmy days of the Egypt Exploration Society at the end of the last century with its present state, and by Mr. H. St. George Gray in his survey of the responsibilities and commitments of the local British societies. Many felt that some form of State assistance was both justifiable and necessary. Others, however, feared that any form of State assistance would involve State control, which might hamper the freedom of research. A solution advocated by Mr. Grimes, and supported by many, was that in connexion with some State organization co-ordinating the different bodies at present concerned with State archæology, there should be some form of grants, made through a responsible archæological body, which would ensure that research as such was adequately endowed, but free of officialdom. Sir Leonard Woolley put forward an eloquent plea for State support for British schools of archæology abroad, with the suggestion that these should be sponsored by the British Council. Other speakers supported his plea for strong British schools, though they deprecated any suspicion that archæology should be used as a means of official dissemination of British culture. Good relations would result from them, particularly if they were open to the nationals of the country in which they were established, but they would be a by-product of the main end, the furtherance of knowledge.

The other main subject discussed was the "Training of Archæologists". The point was strongly made that excavators must receive a sound training in field work. Archæologists in the past had mainly learnt from experience and experiment, usually at the expense in the early stage of a partial destruction of the evidence of an archæological site, and it must be realized, as Mr. I. A. Richmond said, that Roman villas do not exist to provide a Roman holiday for amateurs. The need for training in the environmental sciences was stressed by Dr. F. E. Zeuner. Archæologically-minded geologists and biologists should acquaint archæological students with the processes or phenomena investigated by those sciences, in order that they may know how best to make use of the specialists.

The results of the Conference may thus be summarized: the setting out of the vital contribution which archæology can make to the education of mankind, and the means by which this can be achieved; the emphasis laid on the need for additional financial resources, and the suggestions as to how these should be forthcoming from the State; and the suggestions as to how archæologists should be trained. The Conference closed with a resolution that the problems should be referred to the appropriate bodies for action, those affecting Britain to the newly formed Council for British Archæology, and those affecting work overseas to the societies interested, with the suggestion that they should set up an appropriate organization to deal with them.

OBITUARIES

Prof. Frank Schlesinger

THE name of Frank Schlesinger will always be associated with the determination of stellar parallaxes, for to him is mainly due the considerable knowledge of stellar distances that we now have. It was a fortunate circumstance that his postgraduate research was carried out at the Columbia University, where at the close of the nineteenth century astronomical research work was mainly concerned with the problems of the accurate determination of star positions by means of photography. The great possibilities that photography offered in this field were just beginning to be realized. Schlesinger's thesis for the Ph.D. degree was concerned with the accurate measurement and reduction of photographs of the Præsepe cluster, obtained by Rutherfurd, and showed originality of mind, a thorough grasp of fundamental principles, and ingenuity of method. He was quick to see the possibilities that photography offered for the accurate determination of stellar parallaxes. A short paper, published in 1899, entitled "Suggestions for the Determination of Stellar Parallax by means of Photography", referred to the neglect of this important subject and estimated that not more than twenty-five or thirty stars had known parallaxes which could be relied on to within 0·05″. It outlined methods which Schlesinger was himself afterwards to develop, and showed that he already clearly saw the main precautions that were needed to obtain accuracy.

A few years were to elapse, however, before Schlesinger could try out the suggested methods. He was appointed in 1899 to take charge of the newly established International Latitude Observatory at Ukiah, Ca., but the opportunity came with his appointment in 1903 to the staff of the Yerkes Observatory. He at once started parallax observations with the great 40-in. refractor. In a remarkably short time he developed methods that have since been closely followed by every observer who undertakes the determination of stellar parallaxes. In 1905 Schlesinger was appointed director of the Allegheny Observatory, which had just been reorganized, and for a time his attention was devoted to other problems, mainly of a spectroscopic nature. The results of the work at Yerkes were published in 1910–11 in seven important papers, which have deservedly become classics in this field of investigation. The methods of observation, the possible sources of error and how they could be eliminated or reduced to a minimum, the methods of measurement and of reduction were all comprehensively discussed. For the measurement of the plates Schlesinger designed an excellent long-screw measuring engine, which was made by Brashear. Many other engines of the same design have since been made by Gaertner.

It was characteristic of Schlesinger, when planning large programmes of observations, to consider carefully the accuracy attainable in relation to the expenditure of time in observation and measurement. There is generally a point beyond which further accuracy can be obtained only at the expense of a disproportionate increase in time and labour. As an example, Kapteyn had proposed that parallax plates after exposure should be stored undeveloped for six months or so and then exposed again, so that the parallactic displacement could be determined by differential measurements and the effects of film distortion eliminated. The method involved considerable wastage of material, because ideal conditions at the two epochs could never be obtained, and there were also many possibilities of plates being spoilt by accidents of one sort or another. Schlesinger thoroughly investigated film distortions and proved that their contribution to the final probable error was so small that the slight gain in accuracy was outweighed by the wastage of material and the other disadvantages of the method.

The observations in his short time at Yerkes enabled Schlesinger to determine twenty-eight parallaxes, with an average probable error of ± 0·013″. In 1914, on the completion of the Thaw 30-in. photographic refractor, he started parallax work at Allegheny. In six years he determined 365 parallaxes and obtained plates for several hundred additional ones: the probable error of these parallaxes was about ± 0·008″. He also arranged a carefully planned scheme of co-operation between the seven Observatories of Allegheny, Dearborn, Greenwich, Leander McCormick, Mount Wilson, Sproul and Yerkes. In 1924 he published a "General Catalogue of Stellar Parallaxes", containing the parallaxes of 1,870 stars, all but a few of which were the outcome of this scheme of work.

But this advance in knowledge was restricted to the northern portion of the sky, and Schlesinger therefore began to consider the possibility of erecting a large refractor in the southern hemisphere to remedy the deficiency. In 1920 he was appointed director of the Yale Observatory and was able to bring these plans to fruition. A 26-in. refractor of 36 ft. focal length was set up in the grounds of the University of the Witwatersrand, Johannesburg. The telescope and its housing were designed for the specific purpose of parallax determinations; as the observations are always obtained near the meridian, the motion of this telescope in right ascension is limited to about half an hour either side of the meridian, thus reducing considerably the cost of the installation. Co-operation with the Cape Observatory was also arranged, and the output of these two Observatories has been so considerable that the deficiency of knowledge of parallaxes of southern stars has been made good. The second edition of the "General Catalogue", published in 1935, contains trigonometrical parallaxes of about four thousand stars; including parallaxes determined by spectroscopic methods, the calibration of which is based on trigonometrical parallaxes, it gives the parallaxes of 7,534 stars. The "Catalogue" is not a mere compilation; it is based on a careful critical discussion of accidental and systematic errors to ensure that the probable errors assigned to the individual parallaxes are statistically correct.

Schlesinger's other main work was the determination of star positions from wide-field photographs. The basic ideas were to lighten the burden on the meridian observer, by restricting meridian observations to the brighter stars, and to determine the positions of fainter stars more accurately as well as more economically by photography. Plates covering a large field were necessary to ensure that each plate should contain sufficient of the brighter stars to serve as reference points. Plans for a programme with a lens covering 25 square degrees were drawn up in 1915 and the positions of stars in three zones, each extending over 5° in declination, were determined. Schlesinger then changed to a lens of 5·6 in. aperture and a focal length of about 80 in., using plates measuring 48 cm. by 58 cm., covering an area of 10° in declination and 14° in R.A., with a scale of approximately 100″ to 1 mm. Somewhat later he substituted a more efficient lens of 5-in. aperture, with plates 43 cm. square, covering 112 square degrees. The wide-angle lens camera was mounted on the large refractor at Johannesburg for photographing the southern stars. The measurement and reduction of these large plates introduces a number of delicate technical problems which Schlesinger solved with consummate skill. As the programme proceeded, various modifications and refinements were introduced for greater convenience and accuracy. His latest catalogue, recently published, has probable errors of a catalogue position of ± 0·105″ in each co-ordinate. Since 1925 the positions of some 77,000 stars have been published, a remarkable achievement for a single observatory with a small staff, and a tribute to the efficiency of Schlesinger's methods.

Schlesinger received the honorary degree of Sc.D. from the Universities of Pittsburg and Cambridge. He was elected an associate of the Royal Astronomical Society in 1914 and was awarded its Gold Medal in 1927. He was awarded the Valz Prize of the Paris Academy in 1926 and the Bruce Medal of the Astronomical Society of the Pacific in 1929. His election as president of the International Astronomical Union for the period 1932–35 was a fitting climax to a career of solid achievement. He retired in 1941 but, though he suffered much ill-health in his last years, he continued his work on the zone catalogues to the end. He died on July 10, at the age of seventy-two. He was a man of great understanding, wise in counsel, loyal in friendship and trusted by all.

H. SPENCER JONES.

Mr. C. V. B. Marquand

CECIL VICTOR BOLEY MARQUAND, only son of Ernest David Marquand, author of a "Flora of Guernsey", was born at Richmond, Surrey, on June 7, 1897. He was educated at Elizabeth College, Guernsey (1906–10), Lycée Henri IV, Paris (1910–11), Bedford School (1911–13), and Christ's College, Cambridge, where he took his B.A. in 1919, proceeding to M.A. in 1922. During the War of 1914–18 he served in the Machine Gun Corps, and held a commission in the Royal Tank Corps, from which he was invalided out.

On leaving Cambridge in 1919 Marquand was appointed research assistant in charge of investigations on Avena at the newly established Welsh Plant Breeding Station, Aberystwyth, and published a paper on "Varieties of Oats in Cultivation" in the second Cereal Bulletin of the Station. This was undoubtedly a very useful piece of work, and supplied keys for the identification of all the varieties that could be got together at that time. In 1923 Marquand was appointed assistant (a title since changed to botanist) in the Herbarium of the Royal Botanic Gardens, Kew, and at first continued work on the grasses, but was soon placed in charge of the Chinese section of the Herbarium, and wrote numerous papers on the flora of Eastern Asia, including revisions of the campanulaceous genus Cyananthus (1924), the Old World species of Buddleia (1930), and the gentians of China (1937). He was also interested in the genus Cotoneaster, many species of which are cultivated in Great Britain. He had charge of the Bryophyta (mosses and liverworts), a group which he had always found very attractive, but his other official work naturally left but little time for its study. He combined a passion for mountaineering with a great love of wild Nature, and was an enthusiastic field-botanist, many of his happiest days being spent in bryological holidays in the Alps, the Scottish Highlands, and North Wales. His ecological interests were reflected in a paper on the Bryophyta of Arctic-alpine associations in Wales (1922), and he continued to take a keen interest in genetics during his period at Kew, though he published nothing further on the subject.

Though Marquand was physically very vigorous, his constitution seems to have been permanently affected by his service during the War of 1914–18, and he retired from Kew in 1939 on account of ill-health. He then went to live in the island of Skye, where he was able to devote himself to field-work on the Lower Cryptogams. His tragic death last June on a boating expedition in search of a rare alga came as a great shock to his many friends. Generous, and incapable of a mean action, Marquand was a pleasant companion on a botanizing expedition, which his wide range of interests, not to mention his very decided views, helped to cheer and enliven.

T. A. SPRAGUE.

WE regret to announce the following deaths:

Dr. H. G. Baynes, an authority on Jung's system of analytical psychology and author of "The Mythology of the Soul", on September 6, aged sixty-one.

Capt. F. O. Creagh-Osborne, C.B., formerly director of the Compass Department of the Admiralty, on September 1, aged seventy-six.

Sir Francis Fremantle, O.B.E., M.P., an authority on public health, on August 26, aged seventy-one.

Dr. Aleš Hrdlička, head of the Division of Physical Anthropology in the U.S. National Museum from 1910 until 1942, on September 5, aged seventy-four.

Lady Lockyer, widow of the late Sir Norman Lockyer, founder of NATURE, on September 9, aged ninety-one.

Dr. W. H. Metzler, formerly professor of mathematics in Syracuse University, on April 19, aged seventy-nine.

Sir James Morton, a pioneer in the British textile industry, on August 22, aged seventy-six.

Dr. Cecil Price-Jones, the authority on the sizes of blood cells, on August 29.

Prof. L. Susan Stebbing, professor of philosophy in the University of London (Bedford College), on September 11, aged fifty-seven.

NEWS and VIEWS

Ophthalmological Research at Oxford

AN appeal for £250,000 has recently been launched by the University of Oxford to endow a Research Department in Ophthalmology. The only other university department of this character in Britain at the present time is the Tennant Research Institute at Glasgow, though the Royal Eye Hospital, in conjunction with the Royal College of Surgeons, has recently founded a research chair in ophthalmology. In 1940 Lord Nuffield gave £25,000 to enable the University of Oxford to build a small temporary laboratory for the new reader in ophthalmology and to appoint a research biochemist. This laboratory has been open for a year and work on nutritional and other problems has been started. In 1941 the total blind population of England and Wales was 70,000. Although four and a half million pounds was spent on their welfare during that year, the amount spent on prevention was comparatively small. Apart from blindness, it is perhaps not generally realized how widespread are defects of vision in the population. In 1937, nearly one sixth of the school children medically examined were found with "defective vision and squint". The children in London had a higher proportion of defects than those outside. Recent study of orthoptics justifies the hope of advancement in the relief of these defects in children and emphasizes the need for more work along these lines.

Advances in the science of nutrition have shown that a large amount of preventable blindness occurs in countries where the standard of life of the population is low. For example, deficiency in vitamin A leads to much blindness in children in Ceylon. Although such acute vitamin deficiencies do not occur in Europe, the effect of prolonged sub-optimal nutrition on the eyes must be investigated. Another problem to be examined is the question of illumination in factories and elsewhere. Defective illumination is responsible for many industrial accidents, as well as causing eye-strain among workers, resulting in diminished output. These examples show that what is needed at the present time is collaborative research between the ophthalmologist and research workers in experimental sciences. The department which the University of Oxford hopes to establish will provide facilities for such studies. Oxford is a peculiarly suitable home for such a department, as it already has an eye hospital which has a tradition of research, and collaboration between the medical and non-medical sciences is well established.

Research on Coal

THE colliery owners of Great Britain will provide a further sum, of the order of half a million pounds, for coal research, in order to extend their existing programme, which itself involves the expenditure of £1,000,000 over the current five years. It will be recalled that the Parliamentary and Scientific Committee recently urged a great expansion of utilization research into coal derivatives, adding that although the work should be generously subsidized by the Government, it should be carried out by industry itself. The new programme now announced by the Mining Association of Great Britain relates to the development of processes for producing hydrocarbons and hydrocarbon derivatives from coal, and to the treatment of coal generally as a chemical raw material. It will be put in operation immediately, and the colliery owners will themselves contribute £400,000–£500,000 towards its cost during the period ending with 1945.

Coke and Coal Research

THE investigations of Prof. H. L. Riley at King's College, Newcastle-upon-Tyne, and also those of Dr. R. A. Mott at the University of Sheffield, are concerned with problems affecting the hard coke industry, which enjoys facilities for large-scale experimentation through its member firms such as can only be available to industrial bodies of this kind. The research committee of the body organizing this work visited the Kingston and Fulham Laboratories of the British Coal Utilisation Research Association on September 9. Mr. J. G. Bennett, director of B.C.U.R.A., gave a short address, outlining the organization of his Association and the scope of the work it has in hand. Three main divisions can be distinguished, namely, the administrative, the general research division, and the specialized research departments, the latter subdivided into four or five sections. Within several of the specialized sections there are investigations in progress which will undoubtedly affect coke-oven practice and the quality of the coke that can be produced from a given coal or blend. In particular may be mentioned the 'heat-of-wetting' test developed in the Association's physico-chemical laboratory under Dr. D. H. Bangham. This, and other fundamental work on the structure of coal and coke, was discussed at the recent Conference on the Ultra-Fine Structure of Coals and Cokes held at the Royal Institution. The visitors spent most of their time at Kingston, where they inspected work on the production of high temperatures from solid fuel and other interesting aspects before proceeding to the main building recently opened by Sir Edward Appleton.

Otto Jespersen and an International Auxiliary Language

EARLY this year Prof. O. Jespersen died in Copenhagen. He was a philologist of world-wide reputation who specialized in the English language, was the author of various standard works, and a firm believer in the practicability of an international auxiliary language. His work in this connexion has been ably summarized by H. Jacob in a brochure published by the International Language (Ido) Society of Great Britain, in which we read of Jespersen's active part in elaborating Ido as a revised version of Esperanto, and of his subsequent invention, in 1928, of a new constructed language, called Novial. He was convinced that an international auxiliary language should be based on the material of European languages, should be regularly constructed, have a complete grammar of its own, be flexible and independent of national usages. He emphasized how incomparably easier it is to learn and use such a constructed language than any ethnic language, a view that has been confirmed as the result of a six-years' test by Prof. Thorndike in the United States. English he regarded as easier than other languages, but it would have to be drastically altered, in regard to spelling, grammar, etc., to make it sufficiently simple for international use. Nor has Jespersen any use for Pidgin English: "it would be laughed at and mocked at, and all those millions who know and love the old English language would not consider it a serious attempt to solve an important problem, but would turn away with horror". The attempt to make English an international auxiliary language by reducing the vocabulary is held by many to be invalidated by the many different meanings which some words possess; thus the "New English Dictionary" ascribes sixty-four distinct senses to 'give', sixty-three to 'take', and twenty-five adjectival senses to 'clear'. As the outcome of a life-long study of linguistics, Jespersen believed that language is moving towards ever greater simplicity and perfection; and he quoted Turgot's saying: "Des hommes grossiers ne font rien de simple. Il faut des hommes perfectionnés pour y arriver". This Ido publication can be recommended to all interested in the subject, and especially as it shows no unreasonable bias in favour of its own language.

Centenary of the *Economist*

THE centenary number of the *Economist* worthily maintains the tradition of impartial examination of public affairs which it has established from the days of James Wilson and Walter Bagehot. The factual approach, acute analysis, constructive criticism and the flair for asking the right questions which have characterized it from the start are faithfully reflected in the pages of the centenary issue. Few periodicals can have done more to stimulate the consideration of social and economic questions in the cool serious spirit of science, and it is fitting that in congratulating the *Economist* on the attainment of its centenary, men of science should put on record their appreciation of the contribution which that journal has rendered to the advance of science. In the centenary issue scientific workers will find the articles on "Enterprise and Efficiency", on the Middle East Supply Centre, entitled "An International Example", on nationalization and on "Active Citizenship" of particular interest, but scarcely less stimulating and suggestive is that on "Britain in the World" and the review of the first hundred years and of the policy of the *Economist* which open the issue.

Academy of Sciences of the U.S.S.R.

THE continuing activity of the Academy of Sciences of the U.S.S.R. is indicated in information recently received from Moscow. Two sessions of the Academy were held in Sverdlovsk last year, and another is being held in Moscow this month. All kinds of fundamental research are being maintained despite the urgent claims of war work. Although in the U.S.S.R. scientific workers are exempt from conscription, many volunteered for military service when war with Germany broke out. It is vigorously maintained that this is a "scientists' war", demanding the continuation of scientific research, and in the list of essentials for victory achievements in mathematics, physics and agriculture are given equally high priority with achievements in fields more immediately associated with war. At the forthcoming session, thirty-six new full members of the Academy and forty-two corresponding members will be elected. Among the candidates for election are Drs. Kharkov, Kirill, Sinelnikov and Leipunsky, who are known in Great Britain for their work at the Cavendish Laboratory, Cambridge, and also the polar explorers Vladimir Bize and Nikolai Yukov.

Earthquake in Japan

ACCORDING to radio reports from Tokyo, a serious earthquake took place in southern Japan during the afternoon of September 10. The area most affected appears to have been near Tottori, in which town half the buildings collapsed and more than 1,400 people may have been killed or injured. Tottori is some 100 miles north of Kobe where the earthquake was felt. The shock was also strong at Osaka. Around Tottori railway lines were blocked and telegraph communications were interrupted for a distance of 60 miles to the west. So far no news has been given concerning the area east of the town. Further news is awaited, though it is doubtful in the present state of conflict whether full details of damage done will be available.

The last great shock from near the epicentre appears to have been some sixteen years ago, when 3,000 persons were killed. Earthquakes in the Japanese Islands are relatively frequent, and such as those of July 15, 1941, in the Nagano Prefecture, when thirty houses collapsed killing five people and injuring twelve more, and May 2, 1939, in the Akita district, when 573 houses were completely shattered and 1,218 damaged, killing twenty-six people and injuring twenty-eight others, are common. Most people, however, remember the great earthquakes of Kwanto in 1923, which almost destroyed Tokyo and Yokohama, Tango in 1927 and Idu in 1930, which were fully described by the late Dr. C. Davison. The instability of Japan is part of the instability of the whole of the circum-Pacific circle, though in the case of Japan the instability appears to be enhanced by the proximity of high mountains and great ocean deeps.

'Natural' and 'Supernatural'

IN an article in the *Hibbert Journal* of April 1943, Mr. G. N. M. Tyrrell discusses the ideas which underlie the terms 'natural' and 'supernatural' and suggests that the emphasis so often laid on the words 'nature' and its derivatives is possibly due to a fear that what he calls 'supernature' may try to return. Pointing out that both in psychology and psychical research we find factors in personalities which have properties midway between those of conscious mind and unconscious matter, Mr. Tyrrell proceeds to say that it is now useless to try to defend an outmoded cosmogony in the face of scientific knowledge. The division between the natural and the supernatural must, he says, be discarded; what is wanted is a fuller appreciation of the fact that the question of objectivity and subjectivity is a question of how much or how little do we ourselves contribute to our own world. As Sir Arthur Eddington has put it, when referring to theoretical physics: "the mathematics is not there till we put it there".

Captain Thomas Sumner (1807–76)

JUST a century ago the first edition was published of Sumner's "New and Accurate Method of Finding a Ship's Position at Sea", which contained the first description of the "position line" now universally used both at sea and in the air when navigating by the heavenly bodies. An article by R. S. Richardson (*Pub. Astro. Soc. Pacific*, **55**, 136; 1943) contains some hitherto unknown biographical details of the man who so profoundly changed the methods of navigation. The facts have come to light as the result of a patient search by Dr. W. Van Lennep in the Harvard Library. Sumner was the son of a Boston architect and entered Harvard at the age of fifteen, three years ahead of Benjamin Peirce, later to become the professor of mathematics whom Sumner consulted regarding the merits of his method. At Harvard he studied mathematics and astronomy under John Farrar. Graduating in 1826 at the age of nineteen, he proceeded to sow his wild oats to such effect that in 1829 he found it advisable to enlist as a common sailor in the China trade. Within eight years he had risen to the rank of captain and was master of his own vessel. In 1837 he made the famous journey during which he discovered in dramatic fashion the principle of the position line. After six years presumably spent in testing the method and preparing the MS. of his book, he finally published the work in July 1843. It won instant recognition. It was supplied to every vessel in the U.S. Navy in the year of publication, and ran through several editions in the next decade. During this time, however, Sumner's mind was failing. In 1850 he was committed to a Boston lunatic asylum; in 1855 he was "hopelessly deranged"; and in 1865 he entered the Lunatic Hospital at Taunton, Mass., where he died of apoplexy at the age of sixty-nine, having spent in mental darkness the last twenty-six years of a life full of early promise. No doubt the tragic circumstances of his later life are sufficient explanation of the fact that the standard biographical dictionaries do not record so much as the dates of his birth and death.

Colonial Economic Advisory Committee

THE Secretary of State for the Colonies has set up a Colonial Economic Advisory Committee to give him advice on matters of general economic policy in the Colonial Empire. The members of the committee are: The Duke of Devonshire, Parliamentary Under-Secretary of State (chairman); Mr. G. I. M. Clauson (vice-chairman); Lord Hailey; Sir Bernard Bourdillon; Sir William Goodenough; Sir John Hay; Sir Hubert Henderson; Sir Harold Howitt; Mr. A. Dalgleish; Mr. E. F. M. Durbin; Mr. J. Hallsworth; Mr. J. McFadyen; Mr. J. McLean; Captain B. H. Peter; and Prof. L. C. Robbins. The terms of reference are: "To advise the Secretary of State on such questions of economic policy in relation to the Colonial Dependencies as he may refer to the committee, including particularly matters of general policy arising on programmes of economic development."

B.B.C. Broadcasts on Applied Physical Science

THE British Broadcasting Corporation is arranging a series of twelve weekly talks beginning on October 1 under the title "Science at your Service", on applied physical science. An attempt is to be made to bring before the layman the numerous ways in which physical science is being used in everyday life and to show that an understanding of the principles of science is essential in the post-war world. The addresses will deal with the home, building construction, plastics, clothing and fabrics, explosives, the structure of the earth's crust, the weather, planning fisheries, life-saving at sea, shipbuilding and tunnelling. It is expected that the speakers will include Sir Lawrence Bragg, Sir Edward Appleton, Sir George Burt and Sir Charles Darwin.

Industrial Health and Disease

A WEEK-END course for medical practitioners on factory medical services and industrial diseases will be held at the London School of Hygiene and Tropical Medicine during October 2–3. The course will be opened by Dr. E. R. A. Merewether, senior medical inspector of factories, and lectures will be given on the clinical approach to industrial medicine, occupational pneumoconioses, anæmia in war-time, nutrition and vitamins in war-time, prevention of industrial dermatitis, and rehabilitation with special reference to minor injuries. The fee for the course is one guinea, which should reach the secretary of the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.1, not later than September 27.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Inhibition of Urease by Penicillin

In treating patients with penicillin, our interest has been attracted to the problem of assay of the drug. Difficulties in this connexion are attached to clinical as well as laboratory studies, since it would be of considerable assistance in formulating principles for therapy to be able to measure small, sub-bacteriostatic quantities in the circulating blood. An attempt has therefore been made to discover easily measurable properties of penicillin, and we have found that even highly purified preparations will inhibit the activity of urease.

It has been necessary in this laboratory to work with macro-methods—a technical limitation that has compelled us to employ quantities of drug far in excess of the minimum producing bacteriostasis. Inasmuch as penicillin is extremely valuable and difficult to obtain, we have not attempted to study in detail the quantitative relationships involved.

Urease (Squibb) was prepared as 0·05 per cent solution in phosphate buffer, *p*H 7·3, and 1 ml. was used for each test. Penicillin in the uniform volume of 0·25 ml. water was added to the enzyme solution and the mixture allowed to stand for two hours at 37° C. Urea was made up as a 6 per cent solution in phosphate buffer, *p*H 6·4. 5 ml. of the same buffer was added to the final test solution to bring total volume to 6·75 ml. Urease activity was measured by the aeration method of Van Slyke and Cullen, as ammonia liberated in thirty minutes at room temperature from 30 mgm. urea.

Results of representative experiments are given in the accompanying table. For the most part, a commercial preparation (Merck) containing about 200 Oxford units per mgm. was employed. A large part of this material was composed of impurities which might well have accounted for some of the inhibition obtained. Indeed, attempts to demonstrate alteration in activity after forms of chemical and physical treatment known to destroy bacteriostatic agents produced effects that could not be clearly interpreted. A decrease in the degree of inhibition did occur after acidification, alkalinization and heating; but since the nature and variety of the impurities was unknown, this proves little with respect to the bacteriostatic agent. Of considerably more significance is the fact that a pronounced effect was obtained with samples of highly refined barium salt of penicillin*. This material contained 850 units per mgm. and was thus more than four times as pure as the Merck penicillin. In terms of amount of bacteriostatic agent, both preparations displayed about the same degree of inhibition of urease. On the other hand, the absolute weight employed was in one case 2 mgm. and in the other 7·5 mgm. This may be taken as evidence that the inhibitory activity is largely independent of impurities present.

Effect of Penicillin on activity of Urease.

Experiment No.	Penicillin units	NH_3 liberated (mgm.).
1	0	0·63 in 30 min. at room temp.
	500 (Merck)	0·49 ,, ,, ,, ,,
	1000 (Merck)	0·25 ,, ,, ,, ,,
2	0	0·62 ,, ,, ,, ,,
	2000 (Merck)	0·27 ,, ,, ,, ,,
	2000 (Merck) (autoclaved 120°, 3 hr.)	0·55 ,, ,, ,, ,,
3	0	0·84 ,, ,, ,, ,,
	1500 (Merck)	0·30 ,, ,, ,, ,,
	1500 (Merck) (Kept at *p*H 2 and 37° 1 hr., then neutralized)	0·48 ,, ,, ,, ,,
	1500 (Merck) (Kept in *N*/10 alkali 1 hr., then neutralized)	0·65 ,, ,, ,, ,,
4	0	0·83 ,, ,, ,, ,,
	0 (Containing $BaCl_2$ 2 mgm.)	0·92 ,, ,, ,, ,,
	1700 (Purified Ba salt)	0·40 ,, ,, ,, ,,
5	0	0·78 ,, ,, ,, ,,
	1700 (Purified Ba salt)	0·34 ,, ,, ,, ,,

It would appear that final proof of the action of the bacteriostatic agent in this respect must await the ultimate stage of refinement of penicillin. Meanwhile although speculation with regard to the significance of these observations is perhaps premature, it may at least be pointed out that the peculiar elevation of blood-urea occurring in some patients under treatment with the drug[1] becomes of direct interest. For there is no clear analogy here to familiar clinical disorders that are characterized by urea retention. The absence of albuminuria and the prompt fall in the level of blood-urea upon withdrawal of penicillin argue against a disturbance of the excretory mechanism. An examination of the data given by the Floreys for their patients[1] reveals a relation between dosage of penicillin and the development of elevated blood-urea. Of five adults who received daily an average of 120,000 units or more, four showed a rise in blood-urea, whereas of four who received an average of 100,000 units or less, three maintained a normal level. The suggestion is made that this might be attributable in part to *in vivo* inhibition of urease.

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* Kindly supplied by Dr. E. Chain, of the Sir William Dunn School of Pathology, Oxford.

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Iron Excretion and Metabolism in Man

Until 1937 it was generally considered that iron was absorbed with some measure of freedom in the duodenum and upper parts of the small intestine, and that any taken up in excess of the immediate requirements of the body was excreted into the large intestine. In that year we pointed out that if one neglected the traces of iron always present in the urine and in abraded cells there was no convincing evidence that iron was ever excreted by any of the organs of the body, and that most of the work which had been done tended to show that iron once absorbed remained inside the body[1]. In the years which followed we brought forward experimental evidence to support this theory[2,3,4] which must now be considered also to be well supported by other people's data[5,6,7]. Within the last six months, however, we have had the opportunity of putting the theory to a searching test, and the results have been so convincing that we feel justified in placing them on record.

Mrs. H., aged sixty-six, fit, active and well until September 1942, was admitted to Addenbrooke's Hospital under the care of Dr. Leslie Cole in January 1943. She was found to be suffering from a very severe hæmolytic anæmia, and was specially investigated by Dr. Jacobson. She was kept alive only by frequent transfusions, and between February 11 and May 24 she was given twenty-eight pints of blood, all of which she hæmolysed. This blood must have contained about 8 gm. of iron, and its administration and hæmolysis in just over a hundred days means that about 80 mgm. of the metal were being set free inside the patient every day. If one considers that in the previous September, Mrs. H., as a normal woman, probably contained no more than 4 gm. of iron, it will be appreciated that she was being given more iron than she could possibly require, and that then, if ever, she should have been excreting it.

Between April 16 and May 18 we measured Mrs. H.'s intake and output of iron by the natural channels[8]. Over a period of seventeen days the iron in her food averaged 5·6 mgm. per day. Her urine contained 0·3 mgm. a day and her fæces 4·9 mgm., making a total excretion of 5·2 mgm. She was therefore in the slight positive balance of 0·4 mgm. a day, and there was no suggestion that Mrs. H. was excreting any of her superfluous iron. One can only suppose that she was unable to do so.

Much of the retained iron was undoubtedly stored in the liver, but all the organs probably participated to some extent. We have only had the opportunity of analysing her spleen, for Mrs. H. was cured by its removal on May 25. The organ was enlarged and weighed 350 gm. It contained 0·32 gm. of iron, only a fraction of the amount which had been given.

If the body never excretes iron, it follows naturally[1] that the amount absorbed must fluctuate in accordance with the requirements of the body. Using radioactive iron, Hahn *et al.*[9] showed that this was true for normal and anæmic dogs, but there is still a great deal to be found out about the absorption of iron, and about the ways in which this absorption is adjusted and controlled.

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E. M. Widdowson.

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Aug. 20.

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l-Lysine Decarboxylase: Preparation of Specific Enzyme and Coenzyme

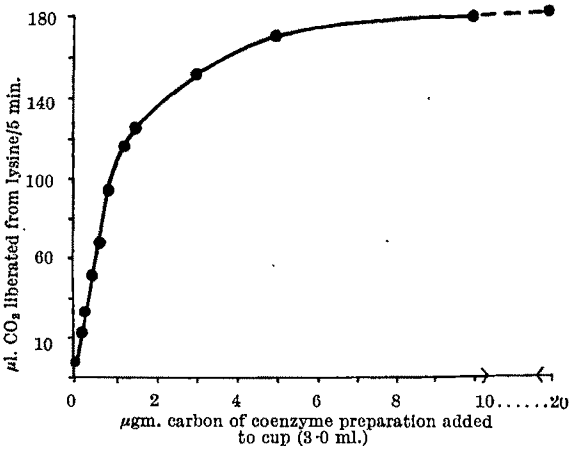
Strains of certain bacteria produce specific amino-acid decarboxylases when grown under acid conditions[1]. A cell-free preparation of *l*(+)-lysine decarboxylase has been made from acetone-dried powders of selected strains of coliform organisms grown for 24 hr. at 25° in 2 per cent glucose casein-digest-broth. A suitable paracolon organism, *Bact. cadaveris*, has been deposited in the National Collection of Type Cultures*. The powder is extracted for 2 hr. at 37° with *X* ml. *M*/45 borate buffer *p*H 8·5 (1 ml. per 20 mgm. powder) and the sediment then centrifuged off. Ethanol is added to the supernatant to a concentration of 20 per cent, the *p*H adjusted to 5 with acetic acid and *X*/2 ml. alumina Cγ suspension (16 mgm./ml.) added immediately. The alumina is twice eluted with *X*/2 ml. *M*/5 phosphate *p*H 7·0 and the enzyme precipitated from the combined eluates by the addition of 50 gm. solid ammonium sulphate per 100 ml. The precipitate is dissolved in water and insoluble material centrifuged off. The opalescent supernatant fluid can be used as a source of specific enzyme or purified a further 10–12 times by fractional ammonium sulphate precipitation as shown in the accompanying table.

Steps in the purification of *l*-lysine decarboxylase from a strain of *E. coli*.

Stage	Preparation	Ml.	Mgm. C/ml.	Total units	$Q^{C}_{CO_2}$
1	Intact organism				508
2	Acetone powder suspension	230	2·6	1610	860
3	Extract from acetone powder	225	2·95	1022	1,850
4	Eluate from alumina Cγ	204	1·02	710	4,100
5	Precipitated with $(NH_4)_2SO_4$ 50 gm. per 100 ml.	100	1·63	571	4,260
6	First $(NH_4)_2SO_4$ fractionation—				
	(a) 0–40% sat. $(NH_4)_2SO_4$	25	1·50	42	1,360
	(b) 40–55% ,, ,,	25	0·97	420	21,100
	(c) 55–65% ,, ,,	25	1·15	23	1,160
7	Second fractionation (of 6b)				
	(a) 0–41% ,, ,,	15	0·869	132	12,200
	(b) 41–47% ,, ,,	15	0·448	232	41,300
	(c) 47–52% ,, ,,	15	0·353	17	3,750
8	Third fractionation (of 7b)				
	(a) 0–42% ,, ,,	10	negligible		
	(b) 42–47% ,, ,,	10	0·209	80	46,000
	(c) 47–52% ,, ,,	10	0·49	131	32,000

The enzyme is tested manometrically at 30° in the presence of 2 ml. *M*/5 phosphate buffer *p*H 6·0 and 0·5 ml. *M*/15 *l*(+)-lysine, the carbon dioxide evolution followed over the first 10 min. after mixing and activities expressed as $Q^{C}_{CO_2}$ = µl. carbon dioxide liberated/hr./mgm. carbon of enzyme preparation. Carbon contents are estimated by the method of van Slyke and Folch[2]. One unit of enzyme is defined as that amount liberating 100 µl. carbon dioxide from lysine in 5 min. Under these conditions, the preparation at stage 5 can be used for the rapid estimation of *l*(+)-lysine; using 0·5 ml. of such a preparation in each manometer for the estimation of 0·5 ml. *M*/30 lysine (theory = 373 µl. carbon dioxide) a series of nineteen tests gave mean gas output of 344 µl.; stan. dev. 4·7; range 337–354. This output represents 92 per cent theory, but if carbon dioxide retention is estimated by the 'acid-tip' method[3], then the output represents 98 per cent theory.

The enzyme is optically specific and has been used for the resolution of *dl*-lysine and the preparation of *d*-lysine. Of the sixteen amino-acids previously listed[1], *l*-lysine is the only one attacked. The molecule is not attacked if it is acetylated in the α or ε position. Samples of hydroxylysine kindly given by Dr. D. D. van Slyke were slowly, but incompletely, attacked. The enzyme is optimally active at *p*H 6·0 and has a Michaelis constant of 0·0028 *M*. The preparations are rapidly and irreversibly inactivated by dialysis against water.



EFFECT OF COENZYME CONCENTRATION ON RATE OF DECARBOXYLATION OF *l*-LYSINE BY SPECIFIC PROTEIN

Manometer cups contain: 0·25 ml. specific protein solution; 0·5 ml. *M*/15 *l*-lysine; 2·0 ml. *M*/5 phosphate buffer *p*H 6·0; 0·25 ml. coenzyme solution containing amounts above.

Two or three successive precipitations of the protein (stage 5) with 60 per cent saturated ammonium sulphate containing 10 per cent ammonia result in the preparation of an inactive protein reactivated by the presence of boiled enzyme, boiled yeast or bacteria, etc. The specific protein cannot be reactivated by coenzymes I or II, flavineadeninedinucleotide, flavinephosphate, thiamin, thiamindiphosphate, etc., alone or in combination. Spectroscopic examination of ashed enzyme does not reveal the presence of any metals. The addition of extracts of boiled tissues to the specific protein shows that the coenzyme has a wide distribution, being present in rat liver, skeletal muscle, heart, kidney, brain and gut; brewer's and baker's yeast; all bacteria tested, and in cabbage leaves and the garden pea. It is not feasible at present to work up bacteria, so brewer's yeast has been chosen as the richest convenient bulk source for the isolation of the coenzyme.

The coenzyme can be extracted from air-dried brewer's yeast by weak alkali but not by water or acid. Since the barium salt is soluble in water, the yeast is first extracted with ten times its weight of 0·75 per cent baryta solution in the cold. Barium is removed from the extract with sulphuric acid and the neutralized centrifugate poured into 5 vol. alcohol. After removal of the precipitate, barium acetate is added to the filtrate and the precipitate collected. The coenzyme is apparently adsorbed on the barium sulphate under these conditions and can be purified some thirty times by exhaustive washing of the precipitate with hot water, followed by decomposition in sulphuric acid. The acid centrifugate is extracted with phenol to remove flavine-like substances, saturated with ammonium sulphate and re-extracted with phenol. The coenzyme is removed from the second phenol extract by shaking with water in the presence of ether. The water solution is acidified with nitric acid, extracted with *iso*-butyl alcohol, the coenzyme extracted from the alcohol with *N*/10 sodium hydroxide and precipitated as the lead salt. The final stage consists of alcohol fractionation of the barium salt. The purest fraction so far obtained is precipitated by 30 per cent ethanol, but a further, slightly less pure, fraction can be obtained by increasing the ethanol concentration to 50 per cent, dissolving the resulting precipitate in water and refractionating with 30 per cent ethanol. The coenzyme can be dried and kept indefinitely as the lead salt. From 1 kilo. dried yeast a yield of 15–20 mgm. lead salt (0–30 per cent ethanol fraction) can be prepared.

This preparation, after removal of the lead as lead sulphate, will activate the specific protein as shown in the accompanying figure, the half-saturation value corresponding to a concentration of 0·27 μgm. C of coenzyme preparation per ml. Over the range where the carbon dioxide liberation is proportional to the amount of coenzyme added, the activity, μl. carbon dioxide liberated/hr./mgm. carbon of coenzyme preparation, is 1,800,000. The coenzyme solution is deep yellow in colour, shows no flavine-like fluorescence, gives a positive Bial's reaction, and gives on analysis of the lead salt (Weiler): C, 22·18 per cent; H, 3·32 per cent; N, 5·07 per cent; P, 3·02 per cent; Pb, 41·2 per cent.

Tested enzymatically, the coenzyme is unaffected by boiling for 4 hr. in *N*/10 sodium hydroxide, but is destroyed in 60–90 min. by *N*/10 sulphuric acid at 100°. These hydrolyses are unaffected by reduction with cysteine or hydrosulphite. Work is proceeding on the nature of the groups in the coenzyme molecule, and it is hoped to publish full details in due course.

We are indebted to the Medical Research Council for a full-time grant to one of us (H.M.R.E.) and for a part-time grant for technical assistance.

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(Beit Memorial Research Fellow.)
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* N.C.T.C. No. 6578.

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Ultra-Violet Light and Apparent Vitamin C

I AM indebted to Dr. Griffiths[1] for pointing out the incorrect reference to the method of preparing reductone which inadvertently was included in our note published in NATURE of July 3. His suggestion that reductones might be produced by the action of the ultra-violet light in sunlight is of some interest.

We have carried out experiments on the irradiation of different dehydrated foods in air, using a mercury vapour lamp with filters to cut out rays below about 280 mμ which would not occur normally in sunlight, and have not obtained any evidence of formation of reductone. Our experiments were carried out on foodstuffs irradiated for different periods up to six hours in aqueous solution at 12 in. from the lamp, using air-filled glass containers (covered Petri dishes). The *p*H of the solutions was between 4 and 6.

Dye titrations on samples taken at intervals showed no increase in the content of reductones or other constituents of apparent vitamin C in foodstuffs in which considerable amounts of this could be produced by prolonged storage in the dark under normal conditions. When foodstuffs were used in which the apparent vitamin C had developed during storage in the dark, this apparent vitamin C was almost entirely destroyed by a few hours irradiation. This is in keeping with the finding of Euler and Martius[2] that reductone has an absorption maximum at 287 mμ at *p*H 5·7 or higher, shifting to 268 mμ at *p*H 4·0 or lower. It would therefore seem desirable in storage experiments on vitamin C to use containers of amber glass which does not transmit any radiation below 370 or 380 mμ. This should avoid photochemical destruction of apparent vitamin C in the form of reductone, reductic acid or dihydroxymaleic acid, also of true vitamin C, which Mohler and Lohr[3] found to have a subsidiary maximum at about 350 mμ in potassium cyanide solution, equivalent to about 340 mμ in water. There is evidence that the vitamin C in fruit syrup stored in white glass bottles under normal conditions may be destroyed by sunlight.

While our results have not provided any evidence for the production of apparent vitamin C by the action of sunlight on processed foods, the position may be different in regard to natural foods such as fruits which are subjected to prolonged solar radiation during ripening and contain enzymes and pigments which may modify the conditions.

FRANK WOKES.

Ovaltine Research Laboratories,
King's Langley, Herts.
July 28.

[1] Griffiths, J. G. A., NATURE, **152**, 163 (1943).

[2] Euler, H. v., and Martius, C., *Annalen*, **505**, 73 (1933).

[3] Mohler, H., and Lohr, H., *Helv. Chim. Acta*, **21**, 485 (1938).

Vitamin C and Carbohydrate Metabolism

IT has been shown previously[1,2] that deficiency of vitamin C in guinea pigs leads to a change in the carbohydrate metabolism as judged by (1) the glycosuria, (2) the diabetic type of the glucose tolerance curve, and (3) the depletion of the glycogen content of the liver. It has also been shown that the normal metabolism of carbohydrate is restored after the administration of vitamin C. From the above evidence, it has been suggested that the action of vitamin C is similar to that of insulin.

In the present investigation the insulin content of the pancreas of normal and scorbutic guinea pigs has been studied. Normal healthy male guinea pigs (200–300 gm. wt.) were selected. Some of the animals were fed on a scorbutic diet consisting of crushed barley, 64 parts; crushed gram, 20 parts; casein, 12 parts; common salt, 1 part; calcium carbonate 3 parts; cod liver oil, 2 c.c.; for a period of 24–28 days, until the animals developed scurvy. Other animals were fed on an ordinary diet consisting of green grass, germinated gram, outer green leaves of cabbage, etc., for two weeks.

Prior to the removal of the pancreas the animals were fasted overnight. The pancreases of 5–7 animals were pooled and extracted for insulin according to the method of Best *et al.*[3]. The crude insulin precipitate obtained was dissolved in normal saline of *p*H 2·5 so that 0·5 c.c. of the solution represented 1 gm. of pancreas. The potency of the solution was tested by studying the hypoglycæmic reaction in rabbits as described by Marks[4]. The results are shown in Tables 1 and 2. They definitely indicate that the insulin content of the pancreas is markedly diminished in scurvy.

TABLE 1. NORMAL GUINEA PIGS.

Aliquot No.	Number of guinea pigs	Weight of pancreatic tissue	Percentage blood-sugar reduction by the extract from 1 gm. of pancreas	Insulin content per gm. of pancreas
1	6	6·0 gm.	16·0	>1 unit
2	7	7·0	30·5	1·2 ,,
3	6	6·0	15·6	>1 ,,
4	7	5·6	13·0	>1 ,,

TABLE 2. SCORBUTIC GUINEA PIGS.

Aliquot No.	Number of guinea pigs	Days on scorbutic diet	Weight of pancreatic tissue	Percentage blood-sugar reduction with extract from 1 gm. of pancreas
1	5	26	5·5 gm.	0
2	6	24	6·0	0
3	5	24	5·0	0
4	6	28	6·0	0

International standard insulin was obtained through the courtesy of Dr. B. Mukerji, director of the Standardization Laboratory, Government of India. Thanks are due to Dr. B. M. Das Gupta, director of the School of Tropical Medicine, for his interest in the present investigation.

SACHCHIDANANDA BANERJEE.

School of Tropical Medicine,
Chittaranjan Avenue,
Calcutta. June 14.

[1] Banerjee, S., *Indian J. Med. Res.*, in the press.

[2] Banerjee, S., *Indian Med. Gaz.*, in the press.

[3] Best, C. H., Haist, R. E., and Ridout, J. H., *J. Physiol.*, **97**, 137 (1939).

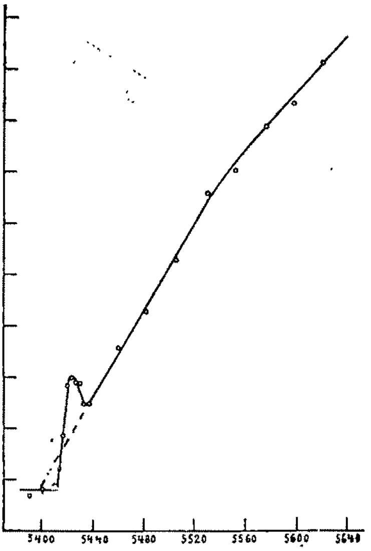
[4] Marks, C. H., Quarterly Bulletin of the Health Organization, League of Nations, Geneva, Special Number, November 1936.

Short Wave-length Limit of the Continuous X-Ray Spectrum and Determinations of h/e

As is known, there exists a discrepancy between earlier determinations of h/e obtained from the short wave-length limit of the continuous X-ray spectrum and the value of h/e calculated from Bohr's formula for the Rydberg constant. Thus most of the determinations of h/e by the X-ray method have given values that are 0·3–0·4 per cent lower than the value calculated. This difference is several times greater than the stated limits of error, indicating the presence of systematic errors in the measurements. An error of this nature, due to too high a pressure in the X-ray tube, has previously been pointed out by me[1]. This error can amount to 0·1–0·15 per cent and is therefore too small to account for the whole of the discrepancy. Further, a number of determinations of h/e have been carried out by means of technical X-ray tubes in which the pressure was sufficiently low.

In the determinations of h/e carried out by me[2], with the aid of a bent crystal and Geiger counter, a very narrow spectral band could be used on account of the greater intensity of the method, and the voltage was varied by very small steps (about 2 volts). Only the very lowest part of the isochromats, up to about 10 volts from the threshold voltage, was investigated. This part of the curves proved to be linear and gave a sharply defined determination of the threshold voltage. The value obtained, $h/e = (1{\cdot}3787 \pm 0{\cdot}0008) \times 10^{17}$ erg. sec./E.S.U. agrees within the limits of error with the calculated value. In a later paper[3] I have described how I investigated the isochromats by the same method, up to 40 volts from the threshold voltage. The curves proved to be linear up to 10 volts from the threshold, where a maximum was obtained. From 10 volts upwards the intensity sank, reaching a minimum at 20 volts and rising again thereafter, though less steeply than before. This indicates the occurrence of a systematic error, by extrapolating from the upper part of the curve.

I have now adopted a series of isochromats of the wave-lengths 2498·42 X.U. (vanadium $K\alpha_1$) and



2285·03 X.U. (chromium $K\alpha_1$) to investigate the size of this error of extrapolation. The illustration shows a curve taken at λ = 2285·03 X.U. Up to 20 volts from the threshold the voltage was varied in 2-volt steps and then in greater steps. The lowest straight part of the curve gives a value of the threshold voltage which agrees with the results of my previous investigations. On the other hand, an extrapolation from the upper part gives a value which is about 0·4 per cent lower.

In previous determinations of h/e broader spectral bands were used. The voltage was varied by steps that were too great to permit observation of the structure at the lowest part of the curves. The extrapolation therefore caused a systematic error and the values obtained were thus too low.

A precise determination of h/e by the isochromatic method is only possible, therefore, if a sufficiently narrow and well-defined spectral band is used, and the voltage varied by such small steps that the structure mentioned above appears.

A more detailed discussion of these problems will shortly be published in *Arkiv f. Matematik, Astronomi o. Fysik*.

PER OHLIN.

Physical Institute,
University, Uppsala. July 20.

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[1] Ohlin, P., NATURE, 145, 223 (1940).

[2] Ohlin, P., Diss. Uppsala (1941).

[3] Ohlin, P., *Arkiv f. Mat., Astr. o. Fys.*, 29, A, No. 3 (1942).

Variations of Ultra-Violet and Daylight Rays

A DAILY record of daylight and near ultra-violet rays has been kept for the last eleven years, covering a sunspot cycle, at a site on the slopes of the Pennine hills about ten miles north-east of Manchester. The results of daily and seasonal observations are of considerable interest, but passing over these, attention may be given to what has taken place in the current solar cycle. At the time of sunspot minimum the daylight and ultra-violet rays had a maximum intensity; and as the number of sunspots increased, the light rays of both classes gradually diminished, and at the sunspot maximum, which occurred in 1937, they came sharply to a minimum intensity. Since then, as the sunspots have grown fewer in number, the rays have again risen to greater intensity and are increasing in intensity as the period of sunspot minimum approaches.

The two classes of rays do not rise and fall at the same proportionate rate, the ultra-violet moving to the highest and falling to the lowest point more slowly than the daylight rays. A graph of the ratio of the ultra-violet to the daylight intensities brings this out clearly, and the graph, so far from being a straight line, shows that the ratio has a variation which agrees remarkably well with the variation of sunspots in the solar cycle.

Sir Edward Appleton[1] has shown that the ionization of the upper air changes in sympathy with the number of sunspots, and consequently the curve of ionization and the curve of the ratio of ultra-violet to daylight rays are closely alike. A consideration of these observations and relationships leads to a tentative view consonant with the facts.

Since ultra-violet and daylight rays are diminished and become least as the sunspot maximum is reached, when the sun is reputed to be most active, it would appear that the rays at that time must be impeded or absorbed. It is at that time that the ionization of the upper air is greatest, and if ionization is indicative of some condition which has the property, or is itself capable, of interfering with the passage of light from the sun to the earth, then the reduction of light intensity at this maximum period would be accounted for. When the impediment to the passage of light is lessened or removed, at the time of fewest spots and least ionization, increase of light intensity would be explained.

It might be expected that the increased activity of the sun at sunspot maximum would give rise to increased ultra-violet radiation, but according to Dr. Pettit of Mount Wilson Observatory[2], radiation of light from the sun could not vary, as it does, by 160–180 per cent in the solar cycle without a simultaneous large variation of the temperature of the sun, of the order of 1,000° C., and evidence for this is wanting.

It would seem that the large range of variation of ionization, and properties accompanying it, is set up by the emanation from the sun which is responsible for auroras and geomagnetic phenomena, and the large changes of ultra-violet and daylight rays are due to effects which accompany ionization and which behave as a partial shield to the rays.

The course of the *daily* and *yearly* variation of both classes of rays, which, however, are due to the changing altitude of the sun, also suggests that they suffer a partial shielding in a similar way.

It is probable that light radiation as it leaves the sun does not vary more than the variation of the 'solar constant', and the inequality of light received on the earth in the solar cycle is the result of an inequality of shielding.

It is interesting to watch at the present time, as the minimum of sunspots is approaching, the remarkable growth of light intensity. In 1937 at the maximum of sunspots, ultra-violet and daylight intensities were, in arbitrary units, 422 and 764 respectively, while last year they rose to 720 and 1,817 and are still rising.

J. R. ASHWORTH.

55 King Street South,
Rochdale. Aug. 12.

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[1] Appleton, *Phil. Mag.*, Ser. 6, 27, 144 (1939).

[2] Pettit, *Astrophys. J.*, 75, 185 (1932).

Spore-forming Bacteria in Potatoes

IT is generally accepted by plant pathologists that no spore-forming bacterium (Bacillus) is directly responsible for disease in plants and that such as are associated with lesions are saprophytes or secondary invaders. Accounts and even detailed experiments[1] have appeared from time to time attributing pathogenic powers to certain species of the *subtilis* group, notably *Bs. mesentericus*, but these have not been confirmed.

In the spring of this year several lots of stored potato tubers affected by bacterial rot were submitted by the Ministry of Agriculture and Fisheries to me for investigation, and from one of these in which the interior had been converted into a gummy transparent mass a spore-forming bacterium was isolated. Provisionally identified as *Bs. polymyxa* (Prazmowski) Migula by Dr. T. Gibson of Edinburgh, this organism produces a complete rot with evolution of much gas when inoculated on to slices of fresh potato, carrots, onions, cucumber and iris stems. *Bs. polymyxa* was re-isolated from some of these slices and re-inoculated into a further series of slices with similar results. This has been repeated several times at temperatures varying from room temperature to 37° C., and there can be no doubt that the spore-former *Bs. polymyxa*, a normal inhabitant of soil, is pathogenic to plants under certain conditions.

Up to the present most bacterial potato rots have been ascribed to the well-known non-spore-formers, *Bact. carotovorum*, *Bact. aroideæ* and *Corynebacterium sepedonicum*, but from the present investigation it seems evident that under certain conditions of storage potato tubers can be rotted by some species of spore-forming bacteria. The conditions under which these bacteria are able to invade tubers are only partially known and merit more extensive investigation than has hitherto been accorded them in view of the serious losses caused. Further work is proceeding.

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Aug. 22.

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[1] Brierley, P., *Phytopathology*, 18, 819 (1937).

Colour of Red Blood Corpuscles

A SINGLE red blood corpuscle, illuminated by white light, appears yellow under the microscope. Why does it not appear pink ? I have asked distinguished zoologists, physiologists, histologists and authorities on colour-vision, but only one has given even a tentative answer, though all have agreed to the fact. The yellow appearance is mentioned by the authors of a few histological text-books, but they either make no comment or else suggest that one would expect yellowness on account of the thinness of the coloured layer. The change of colour of certain dyes on dilution is sometimes attributed to different degrees of dissociation of the dye molecule, but the yellow appearance of a single red blood corpuscle must clearly be attributed to some special phenomenon of colour-vision that is not a matter of general knowledge among biologists.

The subject is important apart from its intrinsic interest, especially in connexion with the application of chemical colour-tests to microscopical objects. It frequently happens that when a red or purple reaction is expected, a yellow appearance is given. This happens particularly with the various aldehyde reactions for tryptophane. Test-tube experiments show a purple or purplish-red reaction, and massive protein-bodies in cells show a similar colour. The cytoplasm itself, however, generally appears yellow in thin sections, and the interpretation is difficult. An understanding of the tendency of pale red objects to appear yellow would help in the interpretation of histochemical colour-tests applied to very minute objects, such as mitochondria and the dictyosomes of the Golgi element.

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Oxford. Aug. 14.

Length of Life of Sperms in the Woodlouse *Armadillidium vulgare* Latr.

RESULTS which could only be explained by the suggestion that sperms can be stored in females of *A. vulgare* for at least a year and that sperms are still viable after this storage have already been published[1,2]. Further evidence for this suggestion has now been obtained. In 1941 the two black females, *EC* and *EK*, were mated with the red males, *JDA* and *JDB*, respectively. Both females produced a brood in the summer of 1941 and they were both kept separate from males in the winter of 1941–42. Nevertheless both females again produced broods in the summer of 1942, and the composition of these broods (brood 176 from female *EC*, 20 red : 17 black; and brood 175 from female *EK*, 8 red : 4 black) shows that they were not produced by parthenogenesis since red colour is due to a single dominant gene.

H. W. HOWARD.

School of Agriculture,
Cambridge.
Aug. 27.

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[1] Howard, *J. Genet.*, 40, 83 (1940).

[2] Howard, *J. Genet.*, 44, 143 (1942).

Ocular Muscles and Vision

THE double function of the ocular muscles, as described in my letter in NATURE of April 10, p. 422, explains many illusions, one of which has been freely discussed without any satisfactory explanation. This refers to the apparent appearance of a moving motor-car or carriage, as if it were standing still. The eye on moving takes a fresh photograph, which is seen for an appreciable time. The decomposed visual purple is swept out of the way by the back pressure. Note the difference in appearance of a tennis or cricket ball when the eyes are still and when they are moving following the ball. A very curious example may be seen at a cinema. If, when an orator is speaking, the eyes be directed to another part of the picture and then immediately be turned back again to the orator, he will be seen quite still, with his mouth open or closed, while his voice goes on.

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London, N.W.2. Aug. 3.

RESEARCH ITEMS

Blood Groups of the Tharus

The Tharus are a primitive people living mainly in fen-land areas of the United Provinces, Bihar and Orissa. Their total population as recorded in the 1931 census is 77,021. Women play a dominant part in Tharu society and the menfolk have adapted themselves to a subservient position. The traditional explanation of this is that the Tharus are offsprings of mixed marriages between Rajput women and their servants. D. N. Majumdar has taken blood samples from 241 males and 82 females, and his results show a very high incidence of the *AB* group (18·4 per cent for males, and 18·3 per cent for females) ("The Tharus and their Blood Groups". By D. N. Majumdar. *J. Roy. Asiatic Soc., Bengal* (Science), **8**, No. 1; 1942). The Tharus, living as they do in a malarious and unhealthy country, have been popularly known as immune from malarial infection. While measuring his sample, the investigator found a number of them suffering from fever, and he noted that most of the latter belonged to group *A*, whereas 78 per cent of the (*B*+*AB*) group said on inquiry they were not habitual victims of malarial infection.

Peruvian Skeletal Remains

The classification and racial relationships of much Peruvian cranial material are difficult to determine owing to artificial deformities. T. D. Stewart has studied metrically miscellaneous undated skulls from the Chicama-Moche-Virú region, and some smaller series from Cupisnique and Mochica graves ("Skeletal Remains from Cultural Associations from the Chicama, Moche, and Virú Valleys, Peru". By T. D. Stewart. *Proc. U.S. Nat. Mus.*, **93**, No. 3160). He comes to the conclusion that the undeformed Chicama series is about as homogeneous as the American undeformed crania available for comparison from one culture or site. He concludes, also, that there are certain significant differences between the deformed and undeformed series that are independent of deformity. There is a possibility that these differences likewise may distinguish the Cupisnique and Mochica remains, the only demonstrable morphological difference of which is based upon the presence of fronto-occipital deformity in the former case. His final suggestion, that the classification of Indian physical types should wait upon a better definition of skeletal material, will find support among other authorities.

Microbiological Degradation of Sterols

In general, the sterol content of soils has received little attention although the wide distribution of free or esterified sterols in animal and vegetable tissues must result, during their decay, in the deposition in soils of an appreciable quantity of sterol substances. G. E. Turfitt (*Biochem. J.*, **37**, 115; 1943) has determined sterol contents of certain British soils and finds that there are definite relationships between sterol content and soil type. Deposition of sterols must depend primarily on the nature and number of the animal and plant inhabitants, so that deposition will be at a maximum in soils favourable to the maintenance of a flourishing population. Extreme acidity, lack of aeration and excessive water content are all factors which, either individually or collectively, inhibit the decomposition of humus and its constituent sterols and are thus responsible for the high sterol content of bog and fen peats. These adverse factors have been counteracted in arable soils, and the content of any soil shows a gradual decrease when replenished by organic manuring. The disappearance of sterols from soils cannot be due to the leaching action of rain-water, since sterols are so insoluble in water, but is probably the result of decomposition by certain acid-tolerant aerobic bacteria.

Salmon of the Irish Rivers

The Fisheries Branch of the Department of Agriculture, Dublin, continues its series of researches on the Salmonidæ in Irish waters ("Salmon of the River Corrib, together with Notes on the Growth of the Brown Trout in the Corrib System", by Arthur E. J. Went. *Proc. Roy. Irish Acad.*, **48**, B, No. 12; 1943. "Salmon and Sea Trout of the Waterville (Currane) River", by Arthur E. J. Went and T. Sankey Barker. *Sci. Proc. Roy. Dublin Soc.*, **23** (N.S.), No. 9; 1943). A large amount of information has now been gathered together on this subject, not only on scales and other data but also on the nature of the waters and geological formations over which they flow. The tributaries of the River Corrib exhibit many diverse characters, ranging from quite acid to alkaline waters having *p*H values of 8·1. The Waterville (Currare) River contains little or no lime; the waters of this system being either neutral or acid. It has not yet been proved by actual examination of the migrating smolts whether those of the individual tributaries are distinctive, but it is suggested that the abnormally large smolts may have been derived from one special locality within the river system. The River Corrib with its varied conditions is ideal for carrying out such an investigation when post-war conditions will allow it, and it is suggested that it would be very interesting to ascertain whether the varied growth-rates of the brown trout in this system have a parallel in growth (and age at migration) of the young salmon from each of these localities.

Thrips Resistance in Cacao

The cacao thrips (*Selenothrips rubrocinctus* Giard) is native to tropical America but is now widely distributed and occurs in most cacao-growing countries. It ranks as an important pest in the West Indies, Brazil, and West Africa. It spends its life on the leaves and pods of the cacao tree, and when attacks are severe defoliation results. The resistance of particular plants to thrips attack is a subject that has been investigated by the Entomology Department of the Imperial College of Tropical Agriculture in Trinidad. A preliminary account of this inquiry by Dr. E. McC. Callan is contained in *Tropical Agriculture*, **20**, 127 (1943). The studies were initiated in 1939 and were based on the fact that it had been observed on occasion that certain individual cacao trees supported very few thrips when the surrounding trees were heavily attacked. Some thirty apparently resistant trees were selected, and of these twenty-seven were found in Trinidad and three in Grenada. Among them *RT*18 is the outstanding selection made, being not only thrips-resistant but also a good commercial type of cacao. Statistical analysis of thrips-population counts on this tree and four surrounding trees shows that the differences between the counts are highly significant, suggesting that *RT*18 is thrips-resistant. Population counts over a period of two years showed that the standard type of tree supports a population more than 7·5 times greater than that of *RT*18. The resistance property of cacao to thrips appears to reside in the leaf, which is to a large extent resistant to puncturing by the mouth-parts of the insect. A method is given of expressing the thrips resistance of a cacao type as a coefficient of resistance. The mean coefficient of resistance of *RT*18, namely, 0·87, is based on the assumption that the susceptible standard type of tree *ICS* has a coefficient 0 and an immune type a coefficient 1.

Cocksfoot Grass

Dactylis glomerata normally has $2n = 28$ chromosomes. *D. Aschersoniana* has $2n = 14$ chromosomes. A. Müntzing (*Hereditas*, 29, 134; 1943) has discovered two haploid plants $2n = 14$ among twin seedlings of *D. glomerata*. In regard to the morphology of the spikelets these haploids were similar to *D. Aschersoniana*, but differed in several other respects from this species. One plant was sterile and rather weak, whereas the other, although male sterile, set seed from pollination of *D. Aschersoniana*. In place of $2n = 14$, the ten seedlings obtained had $2n = 21$, $2n = 24$, and $2n = 28$. The relationship of *D. glomerata* and *D. Aschersoniana* is being studied by the author and it is significant that the haploids obtained from *D. glomerata* differ between themselves in several characters: probably as the result of differing genes on the four sets of chromosomes of the plant.

Oxidation of Nitric Oxide

INVESTIGATIONS of Bodenstein and co-workers showed that the reaction $2NO + O_2 = 2NO_2$ is termolecular and homogeneous; later workers claim to have obtained evidence that there are surface effects and that the reaction is not entirely homogeneous. Stoddart (*J. Chem. Soc.*, 5; 1939) reported curious results, which indicated that reaction did not occur when the oxygen was added to the nitric oxide, and drying was not necessary to inhibit the reaction. J. H. Smith (*J. Amer. Chem. Soc.*, 65, 74; 1943) has re-investigated the reaction, the concentration of nitrogen dioxide being determined by a colorimetric method. Data were obtained over a 100-fold variation of nitric oxide concentration, at pressures from 0·5 to 50 mm. and at the two temperatures 0° and 25°. At moderately high pressures, and at low pressures when adsorption effects are eliminated, satisfactory agreement with previous results was found. At very low pressures adsorption and surface effects became marked, indicating complications due to adsorbed nitric oxide, and oxygen to a less extent. The reaction may be regarded as essentially homogeneous, the irregularities being marked only at very low pressures. Stoddart's result was not confirmed and was perhaps due to the circumstance that only a slight amount of nitric oxide entered the oxygen bulb. The results of the effect of water vapour seem of little interest, since the apparatus was merely warmed in out-gassing, the nitrogen dioxide was in contact with tap grease, and it is not stated if purified phosphorus pentoxide was used.

The System Alumina-Water

Two forms of alumina Al_2O_3, namely, corundum and γ-alumina, two forms of aluminium oxyhydroxide AlO(OH), namely, diaspore and böhmite, and two forms of aluminium hydroxide $Al(OH)_3$, namely, gibbsite and bayerite, are well established. The so-called β-, δ-, ζ-, and trigonal aluminas are spurious. The transition points as found by dehydration methods vary as much as 200°. A. W. Laubengayer and R. S. Weisz (*J. Amer. Chem. Soc.*, 65, 247; 1943) have used the hydrothermal method, which consists in keeping the substance in contact with superheated steam in a bomb. The crystalline substances obtained were identified by chemical analysis and by X-ray and microscopical examination. The products formed at higher temperature (300°–500°) were well crystallized and could be identified by their optical properties. The main results are as follows. Corundum is the stable phase above 450° ± 5°; γ-alumina is metastable throughout the range investigated. Diaspore is stable below 450° ± 5° and its lower limit of stability seems to be about 280°; it was prepared artificially (probably for the first time, as previous claims are very questionable) by seeding γ-Al_2O_3, held at 430° (240 atm.) for 40 hours in water, with diaspore. Böhmite is apparently stable between 155° and 280°; gibbsite is unstable above 155°; bayerite is unstable above 155° and is probably less stable than gibbsite below this temperature. It is noteworthy that diaspore can be obtained only by seeding, and without seeding böhmite is formed in preference to diaspore, even though the latter should be stable in given conditions.

Theory of Cepheid Variables and Novæ

F. Hoyle and R. A. Lyttleton have developed a new theory of Cepheid variables and novæ which has many attractive features, though it must be admitted that it is highly speculative and presents certain complicated features (*Mon. Not. Roy. Astro. Soc.*, 103, 1; 1943). The authors postulate a binary system in which most of the mass of each component is confined to a relatively small volume, and a common atmosphere surrounds both components, but the material of the atmosphere does not take part in the orbital motion of the system. A periodic gravitational field is responsible for *forced* oscillations of the atmosphere—a condition of affairs very different from Sir Arthur Eddington's pulsation theory, which takes account of *free* oscillations in the atmosphere. The physical properties of such a system are dealt with and certain important effects are shown to correspond to observational data. Thus, since the amplitude of the oscillation is greatest at the equator and zero at the poles, it might be expected that the apparent velocity of the surface and the variation in luminosity would decrease with increasing latitude of the earth's direction—a correlation actually discovered in 1937 by Joy. Among the many explanations of the characteristics of the Cepheids may be mentioned that relating to the period-luminosity relation and the $P\sqrt{p}$ law. When accretion by the system has reduced the separation of the components to fusion into a single body, this body would be rotationally unstable if the mass ratio is less than 3 : 1, and stability could be restored only by the ejection of a portion of the main rotating mass. Regions of the star at very high temperatures would thus become exposed and a nova would occur. It is shown that under reasonable assumptions of surface temperature before and during the outburst, an increase in luminosity of 10–12 magnitudes would be expected. In addition, it is suggested that a large amount of atmospheric gases would stream out between the two main components at the time of fission, and this might finally be responsible for the shells of gaseous material which form the planetary nebulæ.

BULB FORMATION AND FLOWER PRODUCTION IN ONION PLANTS GROWN FROM SETS

By O. V. S. HEATH and M. HOLDSWORTH
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THE dependence of bulb formation in the onion on the stimulus of long days has been well established[1,2,3,4,5], and also the interaction of day-length with temperature[3,5]; a day-length just adequate at high temperature fails to induce bulb formation at low temperature, or leads to long delay. With regard to inflorescence emergence ('bolting') Thompson and Smith[3] recorded a large temperature effect but no effect of photoperiod, a lack of response attributed by Heath[5] to the limited range of day-length covered in their work. Heath concluded that conditions favourable to bulb formation (long days, high temperatures) are inimical to bolting and vice versa. In this communication an outline of the further analysis of this apparent antagonism is presented.

In a large factorial experiment we raised plants from sets (small bulbs) in which no inflorescence primordia were present at planting time (March 1942). Throughout the summer these plants were given 11½-hr. daily illumination at each of two temperature ranges (means 18° C. and 26° C. respectively). In early October half of each lot was transferred to 16½-hr. days (daylight supplemented with electric light). At the high temperature range (mean October–January 24° C.) in long days, bulbing began five weeks after transfer and then rapidly became general. No inflorescences appeared in this treatment. At the lower temperature (mean 14° C.) in long days, only 7 per cent of the plants had bulbed by ten weeks from transfer, and even at sixteen weeks when the experiment was ended only 40 per cent had produced bulbs. In this treatment, 7 per cent of the plants had produced inflorescences by ten weeks and 21 per cent by sixteen weeks. It is worthy of note that only one plant bolted *after* having been recorded as showing signs of bulb formation. Among all the plants remaining in short days (11½ hr.) only two, at the high temperature, formed bulbs and none showed inflorescences. The results are presented in Table 1. At the end of the experiment all the plants were pickled and were later dissected to ascertain the stage of development of the growing point. Data from the dissections are given in Table 2.

It is apparent that the plants grown at high temperature in either long or short days showed no signs of inflorescence development but were still in a vegetative condition; whereas at the low temperature in both day-lengths 65 per cent of the plants had initiated inflorescences. A difference, however, is seen, for whereas in the 11½-hr. days only $\frac{12}{65}$ of the inflorescences had scapes of more than 12·5 mm. in length, in the 16½-hr. days $\frac{51}{65}$ showed such scapes. The following conclusions are drawn from the data:

(1) At temperatures low enough to prevent or sufficiently delay bulbing, long days actually accelerate the emergence of inflorescences (Table 1 *B*, column 4).

(2) The action of long days in suppressing inflorescence emergence under conditions favourable to more rapid bulb formation[5] is therefore presumably an indirect effect connected with the bulb development that they promote.

TABLE 1. DEVELOPMENTAL DATA FROM TIME OF TRANSFER (OCTOBER 6, 1942) TO END OF EXPERIMENT (JANUARY 26, 1943).

	Weeks		11½ hr. day		16½ hr. day	
			High temp. (Mean 24° C.)	Low temp. (Mean 14° C.)	High temp. (Mean 24° C.)	Low temp. (Mean 14° C.)
			1	2	3	4
A.	6	% of plants bulbing. ( ) = % ripe bulbs.	—	—	64 (0)	—
	8		—	—	92 (1½)	—
	10		1½ (0)	—	100 (5)	7 (0)
	12		1½ (0)	—	100 (21)	18 (0)
	14		1½ (0)	—	100 (48)	30 (0)
	16		3 (0)	—	100 (67)	40 (2)
B.	10	% of plants bolting.	—	—	—	7
	12		—	—	—	12
	14		—	—	—	19
	16		—	—	—	21

TABLE 2. TERMINAL INFLORESCENCES (EMERGED AND INITIATED) BY JANUARY 26, 1943. (DATA FROM DISSECTIONS.)

	Scape length	1	2	3	4
% of plants with inflorescences	>20 cm.	—	—	—	21
	20 cm.—12·5 mm.	—	12	—	30
	12·5—0·78 mm.	—	38	—	14
	<0·78 mm.	—	15	—	—
	Total	—	65	—	65

(3) There is a direct effect of high temperature in suppressing inflorescence initiation quite apart from the accelerating effect on bulbing, for not a single primordium was found at the high temperature in either day-length, although bulbing in short days was almost negligible.

(4) The rate of initiation of inflorescences is apparently unaffected by length of day, since 65 per cent of the plants showed primordia in each day-length. (The alternative hypothesis, that initiation began sooner in the long-day plants but afterwards came to an end, is less acceptable. It seems unlikely that 35 per cent of the plants were inherently incapable of forming primordia; as for the possibility of initiation being prevented by bulb development in the long-day plants, the presence of unemerged inflorescence initials at the end of the experiment was quite unrelated to the presence or absence of bulbing.)

The acceleration of inflorescence emergence by long days (Table 1 *B*, column 4) is thought to be brought about, in part perhaps, by an observed increase in the rate of elongation of the surrounding foliage leaves, but mainly, by a great increase in the rate of scape elongation (Table 2). In this respect the effect of long days resembles that described for spring cereals[6]. All the evidence to date (including further work by Heath and Mathur) supports the hypothesis that bulbing prevents emergence of the inflorescence, and since foliage leaves are similarly affected[5] it appears that bulbing inhibits longitudinal expansion of all organs. (Sideris[7] records that the original root system begins to die at the time of bulb formation; new roots do not appear until about three weeks later in soil cultures.) It is remarkable that long days by promoting radial extension (bulbing) at moderate and high temperatures should suppress longitudinal extension, whereas at a somewhat lower temperature long days accelerate longitudinal extension. It appears that as the days lengthen in spring a race between the processes of scape elongation and bulb formation must often occur, the resultant incidence of bolting being determined by the diametrically opposed effects of long days according to whether the temperature is or is not high enough for rapid bulbing. To this opposition may be attributed much of the apparently erratic bolting of onions grown from sets in various seasons and localities. The suppression of bolting by high temperatures in the absence of bulbing is unlikely to be of importance in Great Britain, as temperatures are seldom high enough except in the long summer days such as favour bulb formation.

It must be emphasized that the above experiments were performed with sets, and the plants had therefore been exposed to long days in the previous year during their production from seed. A further experiment starting with seeds may therefore be cited, in which the day-length was maintained throughout at less than twelve hours. These plants formed no bulbs, but produced inflorescences after some eighteen months. Clearly, therefore, at no stage during ontogeny are long days essential either for initiation or emergence of inflorescences, unless indeed the particular variety of onion used for this experiment was characterized by an exceedingly low photoperiodic requirement for flowering.

The experiments here discussed and further work now in progress will be published in full in due course.

---

[1] McClelland, T. B., *J. Agric. Res.*, **37**, 603 (1928).

[2] Magruder, R., and Allard, H. A., *J. Agric. Res.*, **54**, 719 (1937).

[3] Thompson, H. C., and Smith, O., Cornell Univ. Agric. Exp. Sta., *Bull.* 708 (1938).

[4] Heath, O. V. S., (Pt. 1), *Ann. Appl. Biol.* (in the press).

[5] Heath, O. V. S., (Pt. 2), *Ann. Appl. Biol.* (in the press).

[6] Purvis, O. N., *Ann. Bot.*, **48**, 919 (1934).

[7] Sideris, C. P., *Amer. J. Bot.*, **12**, 255 (1925).

RESEARCH ON EARLY MAN IN BURMA

OF recent years it has become increasingly evident that so early as lower palæolithic times human culture was not the same all over the world, and that the dissimilarities probably resulted from differences in race. Even in such a small area as the continent of Europe, it is clear from a study of distribution maps of stone age cultures that in Central and Eastern Europe the stone industries differ entirely from those found in the west, and furthermore the two groups undergo quite different developments. Whereas central and eastern Europe can obviously be linked with northern Asia, the stone industries of western Europe show close affinities with the lower palæolithic finds of the African continent. Although skeletal remains of this early date are extremely rare, the few sure indications that have turned up also seem to point to the same connexions. Now a third region has been entered and we find there a series of industries closely allied with others from south-east Asia, but dissimilar to their contemporaries in northern Asia or in Africa.

The *Transactions of the American Philosophical Society* (32) includes a scholarly account of the work undertaken, which was (1) to study the pleistocene period in Burma and to establish a chronological sequence for the alluvial formations of the Irrawaddy Valley, and (2) to investigate any stone age industries discovered in the course of the above researches. Hellmut de Terra, well known for his similar work in northern India, was responsible for (1), Hallam L. Movius, jun., for (2). Supplementary reports on the pleistocene vertebrates and molluscs of the region are given by Edwin H. Colbert and J. Bequaert respectively. There is also a note on an investigation undertaken by de Terra in Java. The geological chapters include studies of the Irrawaddy basin and in the northern Shan Highlands, as well as comparisons with neighbouring areas in India, China and Malaya. Movius describes a series of industries (Anyathian) which appear in early mid-pleistocene deposits. They resemble the Soan complex of northern India, as well as industries found at a number of sites in Java. The Soan always has been considered to have been intrusive in northern India: it would now appear to have been an outlier from Burma. Movius also notes the similarity between the Anyathian and certain heavy industries from Choukoutien, but the typical smaller industries from this area have not been found either in Burma or in Java. The later Anyathian (late pleistocene) though showing certain so-called upper palæolithic peculiarities, is essentially an evolution of the earlier Anyathian, and this is clearly shown from a study of the development of a series of specialized tools made from an unusual material, fossil wood. An interesting collection of neolithic implements and pottery was also made and studied. The first two appendixes are mainly catalogues of the pleistocene vertebrates and freshwater shells found. But de Terra's note on his visit to Java raises again the vexed question of the date of *Pithecanthropus erectus* and that of the newly discovered human remains at Modjokerto. The latter apparently must be considered to be earlier in age than Dubois' find.

In this short note it is impossible to give any detailed account of these investigations. The authors have opened up a new field of study, both in the realm of quaternary geology and of prehistory. Obviously, an enormous amount remains to be done, but the foundations are here for the first time well and truly laid. M. C. BURKITT.

A GIANT CAMERA

AN article by Richard Haard (*Bell Lab. Rec.*, 21, No. 10; June 1943) describes the largest camera of its kind in the United States, this being installed in the Photocopy Department of the Bell Laboratories, making so many as eight hundred negatives a day. It was made by the Rutherford Camera Co. and has one of the largest lenses of its kind in the country—a Goertz apochromat with a 72-in. focal length. The camera also has three other smaller lenses, and all four are interchangeable. With this camera a negative 3½ ft. × 6 ft. may be made as easily and quickly as one 8 in. × 10 in. The photographer works inside the camera, in complete darkness except for a dim red light.

The new camera consists of two rooms with the lenses mounted in a sliding panel in the separating wall. One is a dark room that has a giant "plate holder", called the "camera back", running on a track on the floor that extends through the wall carrying the lens, and into the "light" room. In this latter room, the easel that holds the tracing to be copied runs on a carriage on the same track. The easel is of the vacuum type. The flanged edges of the glass cover fit against rubber gaskets when the cover is lowered, and the vacuum which is then applied holds the drawing flat against the glass face of the easel so that all curves will be accurately reproduced. After this the easel, which is pivoted at the front edge of the carriage on which it rests, is tipped up into a vertical position. It is equipped with piston devices that check its motion at the end of the swings so that tilting it up or turning it back is a simple and rapid procedure. Because of the height of the top of the easel carriage, which is half the length of the easel above the track, a bench 2 ft. high runs the entire length of the track to enable the operator to place the tracings on the easel. Two powerful arc lights on each side of the track near the lens provide illumination.

The "camera back" in the dark room is arranged for two widely different sizes of negatives. The vertical plate against which the paper is placed is perforated with fine holes, and a vacuum acting through them holds the paper flat. If the negative to be made is smaller than the perforated back, rubberized curtains are drawn from the top and bottom and from the two sides to block off all holes except those covered by the paper. Vertical bars control the two side curtains.

Four men form the normal operating crew of the camera. In the light room, a man at one of the work benches measures the drawing, and from the size of the print called for, calculates which of the four lenses should be used. Using a loud-speaking telephone system interconnecting the dark and light rooms, he tells the operator in the dark room the results of his calculation. Four horizontal scales run the length of the tracks in both rooms and are used in setting the positions of both easel and "camera back" in accordance with the size of the drawing and the amount of reduction required. One scale is marked for each lens. After the operator in the dark room has mounted the proper size paper on the "camera back" and selected the proper lens, he moves the "back" to the designated marking on the scale for that lens. In the meantime, another operator in the light room has placed the tracing in the easel, tilted the easel up, and moved the carriage to the scale mark given him by the operator who has sized the drawing.

After the dark-room operator has finished his operation, he looks through a small red glass window in the wall to the right of the lens, and as soon as he sees the easel is in place, he operates a switch that turns on the arc lights. He then rotates a filter into position in front of the lens to cut down all but a negligible amount of light, uncovers the lens, and looks at the faint image of the tracing on the sensitized paper. Using hand wheels at one side of the "camera back", he then shifts the vertical and horizontal position of the lens so as to centre the image on the paper. Following this, he removes the deep filter, or replaces it with one that will best bring out the lines on the drawings, and makes the exposure. He stops the exposure by turning off the arc lights, which also acts as a signal to the operator to place the next tracing in the easel.

The dark-room operator then removes his exposed paper and slides it through a chute to the adjacent developing room, where it is developed, washed, and fixed, and then placed on a glass-top under-lighted table for inspection. Any weak spots are brushed with ferricyanide so that they will print stronger. The negative is then passed through another chute to the washing tanks in the outer room. After the washing period, the prints are dried on the power-driven drier and then passed through the oiling machine. This spreads a thin film of oil on the back to make the paper more transparent, and thus to decrease the printing time. Any excess oil is then wiped off and the negative is ready for printing.

FORTHCOMING EVENTS

Saturday, September 18

British Rheologists' Club (at Loughborough College, Loughborough), at 10 a.m.—Discussion on "Rheology in the Hosiery, Leather, Shoe and Allied Trades".

Association for Scientific Photography (at the Middlesex Hospital, London, W.1), at 2.30 p.m.—Discussion on "Clinical Photography".

Saturday, September 18–Sunday, September 19

Association of Special Libraries and Information Bureaux (at the Royal Society, Burlington House, Piccadilly, London, W.1).—Eighteenth ASLIB Conference.

Saturday, September 18

10.30 a.m.—Annual General Meeting.

11.30 a.m.—Prof. J. D. Bernal, F.R.S.: "Positive Information Service".

2.0 p.m.—Symposium on "The International Rehabilitation of Special Library Services".

Sunday, September 19

10.30 a.m.—Mr. F. C. Francis: "The British Museum as a Special Library".

11.45 a.m.—Major Irving Newman: "The Organisation of American Photographic Information Services in Great Britain".

2.30 p.m.—Symposium on "The Co-ordination of Abstracting".

5.0 p.m.—"ASLIB: What it is Doing and What it Hopes to Do".

Wednesday, September 22

Institute of Metals (at 4 Grosvenor Gardens, London, S.W.1), at 3 p.m.—Thirty-fifth Annual Autumn Meeting.

Friday, September 24

Faraday Society (at the Hotel Rembrandt, South Kensington, London, S.W.7), at 10 a.m.—A General Discussion on "Modes of Drug Action".

Saturday, September 25

British Psychological Society (at Tavistock House, Tavistock Square, London, W.C.1), at 2.30 p.m.—"Education of the Adolescent".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Senior Lecturer in Electrical Engineering—The Principal and Clerk to the Governing Body, Wigan and District Mining and Technical College, Wigan (September 23).

Physicist to the Radiotherapy Department—The Secretary, University College Hospital, Gower Street, London, W.C.1 (September 27).

City Electrical Engineer and City Lighting Engineer—The Town Clerk, Municipal Buildings, Liverpool 2 (endorsed 'City Electrical Engineer and City Lighting Engineer') (September 30).

Assistant to the Advisory Mycologist for the Yorkshire Province—The Registrar, The University, Leeds (September 30).

Chair of Social Medicine—The Secretary, The University, Edmund Street, Birmingham 3 (March 1).

University Lecturer in Anthropology—The Secretary of the Appointments Committee of the Faculty of Archæology and Anthropology, Museum of Archæology and of Ethnology, Cambridge (April 15).

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Ministry of Health. Third Report of the Central Advisory Water Committee: River Boards. (Cmd. 6465.) Pp. 73. (London: H.M. Stationery Office.) 1*s*. 3*d*. net. [198

Royal College of Physicians of Edinburgh. Annual Report by the Curator of the Laboratory for the Year 1942. Pp. 16. (Edinburgh: Royal College of Physicians of Edinburgh.) [248

Plan for Clean Air. Pp. 8. (Epsom: National Smoke Abatement Society.) 2*d*. [248

Freshwater Biological Association of the British Empire. Eleventh Annual Report for the Year ending 31st March 1943. Pp. 40. (Ambleside: Freshwater Biological Association of the British Empire.) 1*s*. 6*d*. [268

Other Countries

U.S. Office of Education: Federal Security Agency. Bulletin, 1941, No. 5: Bibliography of Research Studies in Education, 1939–1940. Prepared by Ruth A. Gray. Pp. xiv+404. (Washington, D.C.: Government Printing Office.) 50 cents. [128

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 92, 1940. Pp. iii+376. (Philadelphia: Academy of Natural Sciences.) 7.50 dollars. [178

Bulletin of the American Museum of Natural History. Vol. 81, Art. 3: Dentitional Phenomena in Cobras and other Elapids, with Notes on Adaptive Modifications of Fangs. By Charles Mitchill Bogert. Pp. 285–360+plates 48–51. (New York: American Museum of Natural History.) [178

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POST-WAR FOREST POLICY IN GREAT BRITAIN

OF the making of plans there is no end, but the White Paper on Post-War Forest Policy* deserves study for a number of reasons. It is of intrinsic national importance; it will affect the pattern of the countryside of Great Britain, particularly in those regions where the landscape is not dominated by hedgerow and wayside trees; while the proposals constitute an interesting example of the development of an industry directed and to a considerable extent financed by the State, but making provision for private enterprise. Moreover, the White Paper gives a summary of the work of the Forestry Commission since it was set up in 1919. It is clear that, within the limitations of policy and finance imposed on it, it has done good work and deserves appreciation from the public.

It is important that Great Britain should have a sound forest policy. First, the two world wars have demonstrated beyond doubt that an adequate reserve of standing timber is a national necessity. Although the available supplies were not large, and to meet the emergency it has been necessary to devastate and disorganize this country's forest resources to a much greater extent than in other belligerent countries, the ability to expand the peace-time home timber production many times over has meant the saving of millions of tons of shipping in both wars, and in both shipping has been vital to victory. The development of air power will only underline this experience. Secondly, there is evidence that the British people are beginning to realize that the full use of land resources is the basis of sustained prosperity. Forestry is one of the necessary uses of land, and a sound forest policy will enable forestry to be integrated with agriculture and other land uses. Thirdly, there is much land in Great Britain suitable for the growing of the kinds of timber we need—mainly softwoods—and from an economic point of view better so used. Fourthly, the British people have great forest responsibilities throughout the Commonwealth, and this, the heart and centre, should give a lead in the proper organization and use of forest resources, both actual and potential.

A sound forest policy for Great Britain must meet certain requirements. It must provide adequate resources in the shortest possible time; it must be wide enough to bring all the benefits which forestry can give to rural development in its widest sense; continuity of aim and effort must be provided for; State and private efforts must be integrated, and provision made for the development of both; an efficient home timber industry to utilize the resources must be maintained and developed; provision must be made for the building up of the necessary scientific and technical knowledge and experience to carry out the policy, and this calls for a vigorous research policy and adequate education of personnel; and lastly, the type and design of the forest authority must be that best fitted for the fulfilment of its tasks. The proposals of the White Paper will be considered in the light of these requirements.

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* Post-War Forest Policy. Report by H.M. Forestry Commissioners. (Cmd. 6447.) Pp. 114. (London: H.M. Stationery Office.) 2*s*. net.

The Report states that the forest area of Britain is about three million acres, or 5·5 per cent of the land area. This is one of the lowest percentages of any country in Europe, and moreover, a considerable part of it has been cut over for war purposes. Other industrialized countries have a much larger percentage under woodland; for example, Belgium 18·4 per cent and Holland 7·8 per cent. The White Paper proposes that a forest area of five million acres be built up in a period of fifty years, made up as to two million acres selected as the most suitable from the existing three million acres, and three million acres of new afforestation. It would appear that this area could be withdrawn from rough grazings over a period without seriously reducing food production. When this has been attained, about 9 per cent of the land area would be under forest, and the timber produced therefrom would ultimately provide about 35 per cent of our present consumption. From the information given, this is the minimum necessary to enable abnormal overcutting in an emergency of three or four years without serious and long-term disorganization of the forest resources, while from a peace-time point of view it does not aim at uneconomic self-sufficiency. It can only be considered adequate under intensive management. It is emphasized that planting alone is not enough, but that subsequent care and tending are essential. The policy to be followed in forest management is not discussed in much detail, although this is an important matter.

The proposals envisage that, during the first decade, 1,100,000 acres would be replanted or planted at a net cost of £41·2 million. This is called the "desirable" programme. An "intermediate" programme of 875,000 acres costing £32 million is also given. If the financial resources and trained personnel are available to carry out efficiently the "desirable" programme, it appears to be more in accord with the needs of the country. The estimated average annual cost of the "desirable" programme during the first decade would amount to less than 7 per cent of the cost of timber imports into Great Britain in an average peace-time year.

The White Paper rightly stresses the timber production aspect of forest policy, but it also deals with rural settlement, employment, and the recreational aspect through the medium of National Forest Parks. The amenity aspect is mentioned. It is noted, however, that smaller woods, and in particular shelter belts, are excluded from the dedication proposals to be referred to later. In certain upland parts of Great Britain there is need for the rehabilitation and extension of shelter belts in the interests of the pastoral industry, and this should be provided in the forest policy, although the work would have to be carried out in consultation with agricultural interests. Land put to productive uses has a beauty of its own, and the amenity value of woods should not be judged from their early stages; but within the limitations imposed by the timber needs of Britain, every effort should be made, both in the pattern of the forests and the species used, to ensure that they accord with the varying structure of our countryside.

The proposals are a long-term plan of investment by the State, the fruits, financial and otherwise, to be gathered in due season. The provision for its carrying out will depend on Parliament and ultimately on public opinion. Means should therefore be taken to ensure that the public is fully informed of the progress of the work by controlled access to forest areas, through the Press, publications, radio and cinema. Adequate publicity is essential for continuity.

The forest policy enunciated by the Acland Committee, which has been the basis of the work of the Forestry Commission since its inception, was impaired by two happenings. First, the Government reduced its grants in two periods of trade depression, while the part allotted by the Committee to private forestry was greater than could be undertaken in the economic and social circumstances prevailing, and no provision was made for the State to make good the deficiency. As regards the first point, it is to be hoped that future Chancellors of the Exchequer and chairmen of economy committees will appreciate that in periods of trade depression, capital investment by the State should be increased and not decreased, while the defect in the previous policy is removed in the present proposals.

It should be emphasized that practically all the timber which has been of such great value to Great Britain's effort in this War and that of 1914–18 was grown by private owners, and that our woodlands are still predominantly privately owned. Moreover, private foresters have, in the past, made important contributions to technical advancement. Britain was the pioneer in the introduction and trial of tree species from all over the world. This was done wholly by private enterprise, and the example and the results have been of great value to forestry development, not only here but also throughout the world. Further, many of the most important technical developments both in Britain and elsewhere have been made by private foresters. Unfortunately, the health and vigour of private forestry has declined, particularly since the War of 1914–18. The causes and their cure are mainly national and not forest, namely, the effects of taxation on rural properties and a feeling of insecurity which particularly affects forestry; but the forest policy should aim, so far as it can, at the resuscitation of private forestry, because it is capable of making our forestry a richer and more varied thing than it would otherwise be.

The White Paper proposes a scheme whereby private owners would 'dedicate' woods. This would involve an undertaking to use the land so that timber production would be the main object, to manage according to an approved plan, to employ skilled supervision, and to keep adequate accounts. In return for this and also for the continuance of the war-time control of fellings, the State would pay 25 per cent of the net annual expenditure when there was a deficiency, and provide private loans at current rates of interest. The scheme provides that all suitable forest land should be dedicated or in due course taken over by the State, land not properly used being dealt with first. The needs of the country necessitate that all suitable forest land be used for timber production. To discuss whether the terms offered are the best and most generous which should be made is outside the scope of this article; it will be in the national interest, however, if it is made possible for owners interested in forestry, small and large, to play their part in forestry development in Great Britain. The task is so large that all who can help are needed, and private enterprise can make a distinctive contribution.

One of the tragedies of the present abnormal overcutting is that the future of the home timber industry is gravely jeopardized. Nevertheless, it is useless to create forest resources without providing for their logging and conversion. The problem is referred to in the White Paper, and it is stated that consultations are proceeding. It is one of great difficulty, but means must be found to conserve and develop the available skill and knowledge of the industry's personnel in such a way that the industry can be readily expanded as increased timber supplies become available in the future.

To fulfil the tasks envisaged by the White Paper will call for personnel in all grades who have the requisite imagination, love of the countryside, scientific background and technical training, and who will have available to them the results of a well-conceived and vigorous research policy.

On the educational side it is important that the right kind of men be attracted and proper provision made for their training, which should not be on too narrow a technical basis in the case of the higher grades. When recruited, they should be encouraged by reasonable conditions of service, and leaders developed by devolution of authority according to capacity. No concrete educational proposals are made in the Report, but these are promised later; it is important that they be adequate.

The outstanding research problems are discussed. There is emphasis on technical problems rather than on the broad scientific fields on which these technical problems rest. It is probable that the development of private forestry will call for research in the economic field of forestry, but no reference to such is made. The principal new proposal in research organization is the creation of a forest research station at Alice Holt. This will involve the withdrawal of the Commission's research workers from universities. The creation of field research stations, suitably equipped, is to be welcomed, and all the principal forest regions of Britain should ultimately be covered, but such centres must be irrigated by streams of thought and ideas from the sciences and arts on which forestry is based. The universities are, or should be, the centres of such inspiration, and such forest research centres should be regarded as seasonal centres only, the research workers being based on universities. This proposal in the White Paper should be reconsidered.

In the provisional estimate of expenditure for the first decade, the allocation for education and research is less than 1½ per cent of the total expenditure. This is certainly not excessive.

The design of the forest authority should, on one hand, promote the efficient and vigorous carrying out of the forest policy, and, on the other, secure adequate contact with Parliament, the source of its funds, and the other departments of State concerned with rural planning and development. The latter will be more important in the future than in the past. A greater area of land will be drawn from other uses, and it appears likely that the countryside of Britain will be more consciously planned as a whole in future.

The White Paper does not propose any important changes in the present constitution of the Forestry Commission. An *ad hoc* authority independent of the Agricultural Departments is proposed. Experience indicates that this is essential to secure vigorous forestry development, but machinery will be necessary for co-ordination with other interested departments and bodies to ensure the integration of rural development as a whole. A single authority for the whole country is also proposed. As agriculture and planning in Scotland is under the Secretary of State, the question of a separate authority for Scotland has been raised. On balance, the advantages of a single unified service are substantial, but it is clear that there should be wide devolution of authority, both in the interests of forestry development itself, and to ensure adequate integration with the agricultural and other departments. The greater the effective devolution, the more certainly will forestry development accord with regional characteristics, physical, social and economic.

The Forestry Commission differs from the usual Government Department in design. It has certain advantages, but one of the drawbacks is that it has no ministerial spokesman, being represented in Parliament by one of its members. While not recommending it, the White Paper suggests that in future it might be represented by the Lord President of the Council, assisted by a committee consisting of the Secretary of State for Scotland, the Minister of Agriculture and the chairman of the Forestry Commission. It may be suggested that the Minister of Town and Country Planning should also be included. Whether this proposal is the best to ensure that forestry is suitably represented in Parliament, and secure, with other means, adequate co-ordination with other interested departments, is a matter for careful consideration before a decision is made.

EDUCATION FOR WORLD CITIZENSHIP

Social Studies and World Citizenship

A Sociological Approach to Education. By L. J. F. Brimble and Frederick J. May. Pp. xii+158. (London: Macmillan and Co., Ltd., 1943.) 6*s*. net.

IF civilization is to survive, a super-national organization will have to be set up in order to restrain the ambition and moderate the selfishness of competing national States. We can no longer afford political anarchy: the world is too small, industry too complex, science too powerful. Our experience with the League of Nations, however, has taught us that the problem is not to be solved merely at the organizational or institutional level. Federations, leagues, world governments will not function unless there exists a public opinion capable of sustaining and animating them.

The formation of the attitudes and mental patterns appropriate to the political organization of the modern world is obviously an educational problem. Rightly directed, the schools could solve it in one generation, but, unfortunately, the obstacles in the way are immense. For education is nowhere looked upon as a revolutionary instrument. On the contrary, it is everywhere closely harnessed to national purposes and its chief task is that of conservation—of guaranteeing cohesion and unity in society.

Yet, even within the existing framework, far more could be done than is done to foster in young people the qualities needed to make them good citizens of the world. Indeed, teachers of vision already do much to inspire in their pupils loyalties which transcend frontiers. It is urgently necessary that their experience be spread wide. In addition, many difficult questions remain to be discussed and explored.

Mr. Brimble and Mr. May intend their book—the first of its kind to be published in England—as a contribution to such discussion rather than as an authoritative and definitive pronouncement. It is not, perhaps, a brilliant, highly finished and polished book—indeed there are many evidences of hasty composition—but it is cheerful, readable and highly provocative. The authors deserve our gratitude for having done a modest job so well and for completing it at so appropriate a moment.

Among the early chapters are "World Citizenship" and "World Democracy". In them, the authors describe the numerous existing international organizations—economic, scientific, medical, financial, religious, etc.—which represent the organs of the embryonic World State. They briefly discuss, too, what is meant by the democratic way of life. To them, democracy involves social and economic duties and they see in it a dynamic which, of necessity, makes it super-national in character: social justice can be attained and maintained at home only if its benefits are made universal. The whole world must be safe for democracy if it is to be safe anywhere: isolationism is its enemy.

Having discussed the application of these ideas to education in general, the authors devote a series of chapters to a closer consideration of what they imply for the teaching of each of the major subject areas in the curriculum of schools—natural sciences, history, geography, etc. They believe that the new spirit "will not show itself by the addition or deletion of this or that subject, but rather will it be evident in the angle of approach and the method of presentation of subjects already in the curriculum". Since the democratic ideals are super-national, they think that the kind of teaching which turns out good democratic citizens of Britain will, of necessity, help to produce good citizens of the world.

This belief leads them to devote much attention to the kind of work best described as "Education for Democracy". They hope that civics will be taught, so that citizens will understand better than they do at present the structure of the government for whose actions they bear responsibility; they suggest that world history be included in the curriculum, so that young people may learn to rise above the love of their own nation to the vision of a developing world community; they recommend that the literary diet include samples (in translation) of the great classics of other lands and that its content be chosen so as not to stress ideals (for example, love and admiration of war and strife) which are inimical to democratic world fellowship; they stress the importance of teaching natural science with due regard to its social applications, so that young people will see in science a major agent of social change and become used to thinking of it in terms of human welfare.

The authors have certainly collected a great store of useful advice which teachers would do well to study. Their book is a mine of practical suggestions, all of which could be applied. To do as they say would greatly increase the efficacy of the work being done and make teaching more vital and significant. At the same time, the book is not free from ambiguities and even contradictions. A scientific reader, for example, may be somewhat perturbed to see so much attention paid to religious education: "The whole of our youth training", say the authors, "should have a religious as opposed to an agnostic background". One's disquiet is not entirely assuaged by the next sentence: "But such training must be based on rational observation and not on emotional feelings and mythical beliefs". It should not be forgotten that (in the words of Prof. J. K. Hart, quoted in the book) though "primitively religion stood for the wholeness of the group, now it often stands for the fractionating of the community, the group and even the individual". In addition, religious feelings are often associated with an attitude of complacent superiority towards men of other faiths, which is not the best foundation for real fellowship. Some of our more religiously minded politicians have not been entirely free from this defect in their public utterances.

One should also note that the theoretical parts of the book are, in general, weak and unsatisfactory. Often the authors approach really difficult and interesting problems and then sheer off. They talk about bias and propaganda, but content themselves by saying it can be avoided. They devote a chapter to "Sex Guidance as a Social Discipline", but do not go beyond giving the ordinary advice with little attempt at fundamental interpretation or at a discussion of the psycho-analytic approach to the problems of aggressiveness and war. They do not consider the obstacles which exist to that proper ordering of our internal affairs and that reshaping of our economic and social order which is the necessary preliminary to the establishment of a world society. There is no detailed discussion of the kind of education required to diminish tension and resolve conflicts of a racial, religious or ideological kind.

It would have been well, too, if more careful attention had been paid to American experience and research. The problem tackled in the United States is in some ways not unlike that which faces us in Europe: how to teach persons belonging to different racial, religious and linguistic groups to live together without fighting. Lastly, it would have been useful to list and to state clearly questions and problems susceptible to objective and scientific treatment.

On one major point, I must join issue with the authors. They urge the imperative necessity of selecting and teaching everywhere an auxiliary world-language. Scientific men do not need to be convinced about this: 'Babel' has indeed become a curse instead of merely a major nuisance, and 'debabelization' must be attempted. But the authors opt for Esperanto, which, in my opinion, has very little to recommend it; its close attachment to European roots and forms militates against its universal extension. Its defects are such that after sixty years of active and ingenious propaganda, very few people can use it.

In fact, there are two—and only two—possible world auxiliary languages. The first is Basic English. The other is Lancelot Hogben's *Interglossa*, which is even more rational and scientific than Basic, and is so simple that it can be learned by an intelligent person in one or two days. It has all the advantages of Esperanto and few of its greater defects.

These criticisms will not, I hope, keep people from reading the book: they are to be taken as an index of vigorous interest and of stimulation. The authors have tackled an original subject and have attempted to pioneer: the proof of their success is found in the amount of praise they arouse rather than in the amount of agreement they receive. How forward-looking and progressive they are can be appreciated only when their book is compared with, say, the Norwood Report on "Curriculum and Examinations in Secondary Schools". This is a dull, turgid and backward-looking document, but it represents, alas, an attitude widespread among persons who have much influence on our educational system. The Norwood Committee has little faith in "Civics", little use for "Social Studies", little interest in "Education for Democracy". It believes that the aims of education must be transcendent and has little hope that guidance can be got from "the provisional findings of the special sciences, whether biological, psychological, or sociological". So far as one can find out from its involved and rather muddy statements, it is even doubtful whether that Committee would agree with Brimble and May's fundamental assumption, which is that the major function of education is to promote the welfare of mankind.

It is against a background of this kind that "Social Studies and World Citizenship" is to be judged if its true value and worth is to be properly appreciated. One hopes it will have the success it deserves, and that it will serve to initiate the fundamental discussion which is so badly needed. J. A. LAUWERYS.

THE RISING TIDE OF SCIENCE

Forward with Science

By Prof. Rogers D. Rusk. Pp. xiv+308+v+24 plates. (New York: Alfred A. Knopf, 1943). 3·50 dollars.

THE impact of science upon society has, as all readers of NATURE will know, already been the subject of much discussion. On one hand there is the optimistic school of thought which prophesies that, if only we employ sufficient men of science and technologists and give them the position of authority in the State to which their indubitable talents entitle them, we shall find ourselves entering into an age of plenty. On the other hand there is a growing, though less vocal, apprehension that for all these good things there may be a price to be paid, and that vigilance will have to be exercised to ensure that moral and spiritual values which are vital to the welfare of mankind are not submerged in the rising tide. The possibilities and the dangers are obviously far more than national in scope, and it was not without interest that one approached this treatment of the theme from across the Atlantic.

"The present volume", so the preface tells us, "aims to fill a definite need in making recent developments in science understandable and meaningful. It was begun in the pattern of a previous volume which treated of modern achievements in physical science and their relation to human life, but with the rising tide of social revolution there emerged even more clearly the urgent need to show where possible what recent developments are of the greatest human significance to-day and how the wave of science is related to the present engulfing social tide." This is a considerable programme for a volume of little more than three hundred pages, two thirds of which are occupied with brief but quite excellent accounts of the latest developments of physics in its 'purest' and most theoretical aspects. It is obvious that, in so brief a space there can be no adequate discussion of the problems raised and, indeed, Dr. Rusk is not arguing; he is telling us. Nevertheless it is good to have both the possible benefits and the inherent dangers of this sudden uprush of scientific achievement into a morally unprepared world so objectively and so honestly set out, as they are in this volume.

Dr. Rusk is not only a physicist but also a student of philosophy (there is, perhaps, just a trace of professional condescension in his dismissal of the philosophical speculations of Eddington and Compton), and takes a rather wider view than the sheer laboratory mind, which is apt to be a little dazzled by the brilliance of its own achievements. "The wave of scientific and technical development upon which the world has been rushing forward", he writes, "represents both a glorious accomplishment and a grave threat. It embodies the utmost in promise for the future happiness, comfort and intellectual achievement of mankind, while at the same time it also threatens the most serious consequences of misuse, leading even to destruction and death." On one hand, "It is not a government committee or a government fund of gold in Washington that can guarantee security in old age and sickness and financial depression; it is science with its potentialities for production . . .". On the other hand, technology has placed enormous power in the hands of a few, partly by the means which it affords for conditioning the mass mind of a nation, and partly by the ease with which the few, armed with modern weapons, can hold down the many. "The unholy alliance between war and science which has made modern warfare possible has intensified the capacity of a dictatorship to make men fight, and the incapacity of a democracy, for no longer can a million effective men spring up overnight."

Further, in the opinion of the author the wave of science has precipitated, or at any rate coincided with, a revolutionary social movement. "The great masses of mankind from the farms of Kansas to the flats of New Jersey and from the steppes of Russia to the mountains of China are beginning to recognize the potentialities of the technical age in which they live and the fact that they have a right to help shape their own future." . . . "No longer can one expect to set up a beneficent static State such as Plato's Republic, and no longer can we expect the unmodified truths of Malthus or Marx to enable us to achieve a final satisfactory static state." In fact Dr. Rusk seems to think that stability is no longer a possibility.

To steer society safely through the uncharted rocks ahead and to justify his optimism (for the book, as its title "Forward with Science" implies, is on the whole optimistic) Dr. Rusk looks to the spread of scientific education among the masses, and to an evolution from within science itself of some moral sense to replace the religious idea of 'sin'. He also cherishes the belief that there is some esoteric relation between science and democracy. In fact he repeats this theme so often that one wonders whether he is not practising a form of Couéism, and hopes by saying it often enough to make it come true; especially as he shows himself fully aware of the fact that, however it may be with science, her half-sister technology sits openly in the market-place ready to bestow her favours on anyone who is prepared to make a bid for them. "Science", he concludes, "is a self-perpetuating movement which can scarcely be stopped. In totalitarian states it has been controlled for purposes of military aggression, and in democratic nations it has risen up in its might to combat totalitarianism. But a controlled science is not a free science, and the essence of science is to be free. Social planning may seek to control the impact on society, but it must not control the spirit of science. Indeed, a free science more than anything else can make social planning possible and workable. But this in turn implies a high technical and moral and social level, and such a level cannot be attained through soft living or soft education, of which there has been too much."

"Forward with Science" is not a great book—one would scarcely rank it higher than first-class journalism—but it is a thoroughly honest attempt by a physicist who has read widely, thought seriously and who has more than average skill in putting his ideas clearly before the average reader, to deal with problems of urgent importance. As such it can be commended to the attention of the rapidly growing circle of readers who are becoming concerned about the impact of the tidal wave of science on the social structure. There is much in the book which deserves anxious thought.

Although, following the lead given by the author himself in his preface, we have dealt mainly with the sociological chapters in the book, it may be added that between them, like the jam in a sandwich, there are some very well-written accounts of the very latest developments in atomic and theoretical physics. Dr. Rusk is unusually successful to conveying to the lay reader the essence of these outstanding achievements of modern science, without worrying him with details which would only confuse, without adding anything of real importance. We may add that the illustrations, with which the book is amply furnished, are the most pleasing we have seen for a long while.

In conclusion, there is one sentence in the preface which I hope Dr. Rusk will agree to modify in his second edition. It reads: "If the scientific and technical level of our nation is continually to rise, as it must *if we are to retain world leadership*, the achievements of science cannot remain only for the cloistered few." The words in italics are, of course, common form, and could easily be paralleled from articles and reports in Great Britain and no doubt in Germany, the U.S.S.R. and elsewhere, but has not the time arrived when men of science, at any rate, might come to regard their work not as part of an international struggle for world leadership but rather as a common service for the good of humanity as a whole? If not, the outlook for society is indeed bleak. I feel sure that Dr. Rusk will agree. J. A. CROWTHER.

ABSORPTION SPECTRA IN MEDICINE

Spectrophotometry in Medicine

Being the authorised translation of "Medizinische Spektrophotometrie" by Dr. Ludwig Heilmeyer. Translated by Dr. A. Jordan and T. L. Tippell. Pp. xiv +280. (London: Adam Hilger, Ltd., 1943.) 30*s*. net.

THE German edition of this work was published in 1933 by G. Fischer of Jena. The author, working at the Laboratory of Clinical Medicine at the University of Jena, had by then made substantial use of modern methods of spectrophotometry for investigating body fluids, and at the outbreak of the War was still publishing valuable work in this field. His book received scant attention in British and American journals, but as the subject-matter grew in interest and significance and a knowledge of spectrophotometric technique became more widespread, the need was felt for a translation. The book was naturally somewhat out of date in 1939 and it cannot be doubted that, but for the War, Heilmeyer would have desired to revise some of the chapters rather drastically for the English edition.

The translators were faced with a difficult problem. The symbols in use in spectrophotometry have now been agreed upon and differ from those used in the German original, and the newer ones have been used throughout the translation. The description of spectrophotometric technique has been discreetly brought up to date, and here and there useful footnotes on recent work have been added. The work as a whole, however, remains as it was written and the very careful translation deals faithfully even with some obscure passages.

It is necessary to emphasize that clinicians and research workers using this book will need to search the literature of the last ten years for themselves.

The work consists of six parts. The first deals with the theory and technique of spectrophotometry and is excellent. The second is concerned with absorption spectra applied to blood and hæmoglobin derivatives, and provides a very convenient summary of a difficult field. Part 3 covers the first breakdown products of hæmoglobin, and is a section which will need much revision and amplification in the light of recent work. The fourth part deals with blood serum and both normal and pathological serum pigments. Bilirubin and synthetic bilirubinoid pigments, as well as the lipochrome pigments, are reviewed, but there is no mention of vitamin A, concerning the determination of which in sera there is now a considerable literature. The next part discusses the spectrophotometry of urine, urobilin, urobilinogen and uroerythrin, together with urochromes A and B. Hæmoglobinuria and porphyrinuria are considered as fully as the state of knowledge in 1932 justified. There is finally a short section on bile, ascitic fluid and cerebrospinal fluid. The translation is ably and copiously indexed.

The chief virtue of Heilmeyer's book is that it unites a thorough knowledge of spectrophotometry with the systematic study of pathological material available in a university clinical laboratory. In this respect it is unique and indispensable. It shows convincingly how much has been achieved in the field, and it is greatly to be hoped that this translation will prepare the way for a new edition after the War. In the meantime the present issue can do much to promote co-operation between spectroscopists and pathologists. R. A. MORTON.

SCIENCE IN WESTERN SZECHUAN

I. PHYSICO-CHEMICAL SCIENCES AND TECHNOLOGY

By DR. JOSEPH NEEDHAM, F.R.S.
British Scientific Mission in China

IN the foregoing articles of this series* the attempt has been made to report to Western scientific men something of the remarkable efforts of their Chinese colleagues in a pre-industrial hinterland lacking all modern resources. The attempt is here continued with respect to the western parts of the province of Szechuan, lying between the Tibetan borderlands to the east and the Yangtze valley in Hubeh to the west.

The principal city of western Szechuan is Chengtu. When Chinese jokingly discuss which city of Free China represents the lost cities of eastern China, Chengtu is always analogized with Peiping; and it does indeed have the air of ancient city culture. It covers a very large area, much of the city wall still stands, and it is rich in old bookshops. It might remind the English visitor of York (for some of the Buddhist abbeys are reminiscent of any cathedral close) if it were not so flat, with willow-fringed canals not unlike those of the Cambridge fens. Chengtu has for many years been the home of the ('missionary') West China Union (Huahsi) University, the buildings of which, erected in semi-Chinese style on an admirable campus, are now by far the best of any university in Free China. This University has very hospitably accepted no fewer than four other universities (all originally 'missionary', now known as 'private', as opposed to State, or national, universities) as evacuees, namely, Chilu University from Shantung, Yenching University from Peiping, Nanking University from Nanking, and Ginling Women's College (the Chinese counterpart of Girton College, Cambridge), also from Nanking. The total number of students is to-day somewhat more than 3,000, of which two thirds are men and one third women. In general, it may be said that these private universities concentrate mainly on undergraduate teaching and less on the higher walks of research than some of the other Chinese universities, but the importance of a great centre of student life under comparatively good conditions of existence in these days should not be underestimated. Among the presidents of these institutions are some internationally known scholars, such as Dr. Mei Yi-Bao of Yenching, the translator of the philosopher Mo-Tze, and Dr. Wu Yi-Fang of Ginling College.

A good deal of fusion of the scientific departments of these Universities has taken place in practice, though theoretically they are still distinct. In general, research interest is concentrated on practical problems of importance to the community. Thus the chemists of Huahsi University (Profs. Roy Spooner and Chang Chuan) direct investigations on the indigo and natural dyestuff industry of the province, on gelatin emulsions with reference to the production of X-ray plates, on the properties of Chinese soapnut saponins, on electroplating, and on tanning, for which there is an elaborate experimental plant established on the campus. Here all kinds of improvisations, under Dr. Chang's initiative, have had to be thought of; all the machinery is made of local woods, and when emery wheels cannot be had, one imitates them by setting broken glass in a medium of tung oil. In Chilu University, Prof. Hsieh Yu is interested primarily in the active principles of indigenous drugs, especially anti-malarials. In Ginling University, Prof. Tai An-Bang, a colloid chemist, supervises work on soy-bean globulins (important for the production of 'casein' glue), copper insecticides, and tung oil polymerization. It will be seen that here, as much as, if not more than, in any other Chinese universities visited, research on immediate war problems is going on, just as in Britain. But the burden of teaching weighs heavily on the staffs of these Universities, and until it is lifted attainment of a high level of research can scarcely be expected. One of the most outstanding scientific men at Chengtu is probably Dr. Li Fang-Hsun, the physical chemist of Ginling University, whose work on ionic entropies, ionic volumes, hydration, etc., is widely known. So also is the work of Dr. Li Hen, the mathematician and astronomer of Huahsi University, a member of the National Academy.

One of Dr. Li Fang-Hsun's colleagues, Dean Wei Shich-Rjeng, an extremely capable organizer, has collaborated with the progressive director of education of Szechuan province, Commissioner Kuo Yo-Shou, in setting up a factory for producing school and simple laboratory apparatus. This goes out to eleven other provinces as well, and includes good chemical balances weighing to 1/5 mgm. and all imaginable physical and chemical apparatus and chemical reagents. The plant includes a glass factory. To illustrate the primitive conditions which must often be overcome, it was remarkable to see a dynamo for providing a low-voltage electric current for electroplating operated by hand, as no main current is available in this region outside the city. Mention may also be made at this point of a Popular Science Hall, planned along the lines of the Science Museum at South Kensington, but only just installed in some buildings of an old temple. It was pleasant to see in the garden stone models of the principal figures in solid geometry, with inscriptions in Chinese assiduously studied in the shade of the trees by small Chinese boy scouts.

The best applied physics and chemistry in Chengtu is probably going on in the experimental establishments of the Chinese Air Force Research Bureau, directed by Colonel Wang Tzu, but details cannot be given here for security reasons.

Turning now to a few words on the technology of the region, which is exceptionally interesting, China has in the Tzuliuching (lit. "Self-flowing Well") area an inspiration to her modern industrial chemists. For centuries back, so far that the memory of man runneth not to the contrary, there have been brine wells in this area, sunk by local methods using bamboo rope-suspended drills working for perhaps twenty years to complete one boring, and producing several sorts of brine, black, white and yellow. These brines are of different composition, and from them, by modern methods, partly in private factories, and partly in plants under the National Resources Commission, numerous important salts are separated (for example, salts of barium, boron, magnesium, lithium, strontium, bromine, etc.). Not many miles away, at Fivebridges, the Huanghai Industrial Research Institute (a privately supported organization on the same lines as the Mellon Institute at Pittsburgh, but in an entirely rural setting, ably directed by Dr. Sun Shioh-Wo and Dr. Chang Chien-Long) analyses these brines and works out new methods of separating their constituents.

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*See NATURE, July 3, p. 9, July 10, p. 36, and July 17, p. 64, 1943.

The brine region is indeed nothing more nor less than an industrial area in the midst of a vast pre-industrial country and civilization. Needless it would be to point out the fundamental importance of such a source of salt in Central Asia so far from the sea-coast. The technique remains primitive to this day; a bamboo cable drops down the boring for two or three thousand feet and is wound up on a huge horizontal drum driven round by oxen. Steam and electric winding-gear is now, however, being introduced. But yet another circumstance is remarkable, namely, that the brine is associated with enormous amounts of natural gas, and one may see vast halls with hundreds of pans of evaporating brine each heated by a large burner connected with a boring. Still more extraordinary is the use of bamboo piping for conveying the brine from the wells to the factories over miles and miles of country. These bamboos are bound round outside with bamboo strips and cemented together with tung oil and lime; they stand a pressure of 80 lb. per sq. in. Unfortunately, bamboo will not do for water-supply in towns, as it is rotted by fresh water.

Such is ancient chemical technology in west China; the new has other features we must admire. Under the National Resources Commission, industrial plants have sprung up everywhere in Szechuan. In the sugar-producing area around Inwardstream (I garble-translate the place-names as usual), there are large works producing power alcohol from molasses for motor-vehicles; that directed by Dr. Chang Chi-Hsi is an example. Urea from human waste serves systematically here as nitrogen-source for culturing the yeast. Near Fivebridges there is an admirable low-temperature carbonization plant (the coal supply is difficult, seams being usually only 2 ft. thick over a wide area) directed by Dr. Huang Rjeng-Chi, and a wood dry-distillation plant directed by Dr. Gao Chang-Kung. Now the characteristic of all these plants is that they are usually built and operated by men of general chemical engineering training but without special experience, who went, as it were, into the wilderness and 'created' (the French idiom alone expresses it) the beginnings of industry, under the urge of war but with an eye to the peace. From the high lecture-hall of Wuhan University at Chiating, a lovely town at the junction of two great rivers tributary to the Yangtze, one sees in the far distance two things—a statue of Buddha 360 ft. high carved in the cliff, and on the other side a factory chimney. The social gospel of Confucian this-worldliness is conquering at last.

Wuhan University at Chiating, presided over by Dr. Wang Hsing-Kung, himself a chemical engineer, is housed partly in a beautiful Confucian temple, with its library occupying the shrine of the sage itself; but the physico-chemical departments are located in an old family temple with a charming loggia on the top of the city wall overlooking the river with the great Buddhist place of pilgrimage, Mount Omei, in the distance. Here Dr. Hu Chien-Shan (one of Prof. P. M. S. Blackett's most eminent collaborators) works and teaches; he has just completed a book in Chinese on cosmic rays. Head of the Chemistry Department is Dr. Wu Pao-Liang, the physical chemist, who has recently published an interesting work on omni-range electrical forces and static nuclei. He emphasized the isolation of scientific men in this remote spot in his need for up-to-date data on nuclear masses. The theoretical physicist is Dr. Chiang Rjeng-Shou (a former collaborator of Prof. E. N. da C. Andrade); he is directing the work of Liu Li-Ben on copper oxide rectifiers and that of Lo Wei-Kuang on the effect of temperature on elasticity in metals. In chemistry, Dr. Yeh Chiao investigates the active principles of indigenous drugs. While at Wuhan I had the pleasure of seeing a microfilm-reading machine arrive from International Cultural Service at Chungking (this deserves an article to itself) together with many microfilms. We got the machine working and the first films at which we looked were *Science* and *Journal of Nutrition* up to February 1943. The delight of these isolated men may easily be imagined. But nearly all the material so far coming in this way is from the American side, and on the British side we are only just belatedly beginning.

There is no doubt that at Wuhan University the scientific level is very high, comparing favourably even with the National Southwest Associated Universities at Kunming. Chiating, however, contains other institutions of some interest. We may mention the Polytechnic College, where courses are given in all branches of chemistry and engineering pertaining to light industry; for example, in agriculture, paper-making, textiles, leather and sericulture. The lonely location of all this region may be visualized by the remark made by the engineer of one of the National Resources Commission power stations, who said, as we stood at the door looking towards the Tibetan border mountains, "Remember that this is the last power plant until you come northwest to the Soviet Union across Central Asia six degrees of longitude west and three degrees north!"

Another academic institution of the first rank is Tongchi University, situated in the very small town of Appletree Rapids a hundred miles or so down the Yangtze. It was originally the German-Chinese University, and the atmosphere is still mainly German, though of course anti-Nazi. Its president is Dr. Ting Wen-Yuan, a younger brother of the famous geologist V. K. Ting. Its headquarters are in an extremely beautiful temple beside the river dedicated to Ta Yü, the legendary engineer who first established China's irrigation systems. Under the carved and gilded beams and roofs portraying the life of this great organizer and technologist, the students gather for special lectures or pass to and from their classrooms. I was privileged to be there on the annual day dedicated to Ta Yü's memory, and to address the students, after the usual ceremonies and a speech on the work of engineers in China by Dr. Ni Chao. Here at Tongchi the departments of physics and chemistry live but a struggling life, for as at Wuhan, their apparatus was much damaged by bombing and transportation from the east, but the engineering departments are flourishing. The University has its own power plant, and the students spend much time in assembling and erecting a large amount of plant brought up-river. There is United Nations collaboration here, for the professor of steel construction is a Pole. Particularly striking is the Department of Geodetics, Surveying and Cartography under the able Dr. Yeh Shwi-An, with excellent equipment; this has almost a monopoly of the production of Chinese surveyors and mapmakers.

The definitely religious veneration paid to the great irrigation engineer, Ta Yü, is of much interest. Some distance to the north-west of Chengtu there is a town called Kuanhsien, where may be seen what must be one of the most remarkable irrigation works of the world. A great river, the Min Chiang, issuing from the mountainous country of the Tibetan borderland, is there diverted at certain seasons of the year by movable dams and spillways into an enormous cutting through a hillside, forming thereby an artificial river which fertilizes 500,000 acres of first-class agricultural land by means of 1,200 km. of irrigation channels. But the striking feature of the work is that it was begun in 250 B.C. by Li Bing, then governor of this province, and has been kept up ever since. Moreover, the Chinese were not content to regard such works from a purely utilitarian point of view. With their characteristic ability to raise the highest secular to the level of the numinous, they built upon the outermost spur of the hill through which the river cuts, a magnificent temple to Li Bing, and farther up, in a scarcely less beautiful situation, a wooded hillside next the river, another one to his son, also an irrigation engineer, Li Erh Lang. Note the contrast: incense sticks glow in the front of Li Bing's temple, but in its second court are numerous models of the improvements it is intended to make to the irrigation scheme. So also in Li Erh Lang's temple, the engineers have their living quarters, and the shrine and courtyard of Ta Yü is the Water Conservancy Office. In the middle of all this ancient culture, all these exquisite buildings, Li Bing's latest successor walks about, a slide-rule sticking out of his pocket, and with a Manchester training—Dr. Chang Yo-Ling. The British Scientific Mission has had particular pleasure in transmitting some of his papers for publication in British engineering journals.

It would be a delight also to speak of the chemists and engineers in the arsenals in this part of China, of their initiative and perseverance in erecting and operating up-to-date plants in the midst of the wilderness, and of the clever use that has been made of natural caverns for the protection of war science laboratories and special up-to-date machinery. But for security reasons this cannot be done. No one, however, could say, after seeing what the Chinese have done in technology, both ancient and modern, that they are a people inapt for the scientific control of Nature. If modern science did not develop in their country, it must have been due to specific inhibitory social and economic factors, and certainly not to any incapacity of the people themselves.

The tragic feature in to-day's situation is the economic straits of Chinese scientific men, especially in the universities. The steeply rising cost of living has hit them very hard, and neither the special rice allowances of the Government, nor the staving off of the evil day by the gradual selling of all the family possessions down to the children's dolls, avail to provide them with even a moderate standard of comfort and to guard against malnutrition. But this must be the subject of a later communication.

FEEDING HORSE CHESTNUTS AND ELDERBERRIES TO POULTRY

By H. TEMPERTON

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THE commercial poultry keeper, faced with an acute shortage of concentrate feeding stuffs, has been compelled to exercise considerable ingenuity in finding suitable supplements to eke out his food allocation and so maintain a reasonable proportion of his pre-war numbers of stock. The same problem, although to a lesser degree, has confronted the domestic poultry keeper, who is allocated sufficient meal to furnish approximately half the daily food requirements of his birds. Thus a person qualifying for rations for only four birds requires an additional half-pound of dry food substance in order to provide a satisfactory daily ration for this number of stock. It is estimated[1] that the daily amount of edible waste in the average small English household is approximately one pound of fresh substance, or approximately four ounces of dry matter. The further daily requirement of four ounces of palatable and nutritive dry matter must, therefore, be derived from other sources. The poultry Press, adopting the principle that no potential food source, however small in quantity relative to needs, should be despised, has frequently suggested the nutritive possibilities of natural food materials and requested youth movements and other voluntary services to collect acorns, horse chestnuts and beech mast for stock feed.

Reference to the available literature provides little experimental evidence of the value and effects of feeding such natural food materials to poultry, and it was considered desirable to obtain timely information. The use of acorns as a food for laying birds has already been described[2], and the present article gives an account of experiences with the feeding of horse chestnuts and elderberries.

Horse Chestnuts

The chemical composition of horse chestnuts is very encouraging, the dry matter being similar to barley, as shown by the following analyses (Woodman[3]):

AVERAGE COMPOSITION PER CENT

	Dry Matter	Protein	E.E.	N.F.E.	Fibre	Ash
Barley	85·1	10·0	1·5	66·5	4·5	2·6
Horse Chestnuts (Fresh) ..	50·8	4·3	1·5	40·9	2·5	1·6
Horse Chestnuts (Dry) ..	81·2	6·9	2·4	65·2	4·1	2·6

A characteristic constituent of the nitrogen-free extractives is a glycoside, esculin (æsculin, æsculinic acid) $C_{15}H_{16}O_9$, which on hydrolysis yields esculetin (æsculetin, 6,7-dihydroxy-coumarin) $C_9H_6O_4$ and glucose. Horse chestnuts also contain the glycoside quercitrin (quercinetrin, quercitrinic acid) $C_{21}H_{22}O_{12}.2H_2O$, which includes the ω-desoxy sugar, *l*-rhamnose. On hydrolysis, quercitrin yields quercetin (meletin, sophoretin, quercitrinic acid, flavin) $C_{15}H_{10}O_7$.

Esculin is a saponin and produces the characteristic soap-like foam which is apparent when cooked horse chestnuts are masticated. A sweet flavour remains which later turns to a bitter after-taste due to the presence of *l*-rhamnose and of gallotannin (gallotannic acid), a further constituent of horse chestnuts. Gallotannin is largely hydrolysed to gallic acid during the cooking of the nuts. Klimmer[4] refers to deaths among poultry due to tannic acid poisoning following the feeding of horse chestnuts. It is unlikely, however, that this constituent was responsible, since in an experiment[5] carried out with laying pullets the daily dosage of birds with 1·12 gm. of gallotannic acid over a period of twenty-five days did not adversely affect health or egg production although the birds were costive.

Outline of experiment. Four groups each comprising four cross-bred pullets which were in lay were used for the test and accommodated in individual cages in a battery house. Horse chestnuts at the daily rate of ½ oz. per head were added to a ration consisting of 4 oz. of a balanced laying meal. Four forms of air-dried ground chestnuts were fed as follows:

Group 1. Raw chestnuts.

Group 2. Boiled chestnuts.

Group 3. Chestnuts which had been steeped in water for forty-eight hours prior to cooking.

Group 4. Chestnuts which were leached in warm water for forty-eight hours after cooking.

The various forms of chestnuts were mixed with the appropriate quantity of mash and fed as a wet feed. All four rations proved markedly unpalatable and no improvements in this respect resulted from the efforts to debitter the chestnuts fed to groups 3 and 4. Where the birds could discriminate, the particles of chestnuts were thrown out of the troughs and they only ate the meal portion. In groups 2, 3 and 4 where the chestnuts were cooked and mixed intimately with the mash so that the birds were unable to distinguish the individual components, the ration as a whole was left untouched. A new set of birds which had had food withheld for the previous twenty-four hours were offered the four rations. Although obviously hungry they refused to eat more than a preliminary mouthful.

The supply of horse chestnuts used for the test was made available through the industry of local schoolchildren. The nuts were collected soon after they had fallen from the trees and stored in thin layers on the floor of an airy shed and turned frequently. Despite these precautions, 50 per cent (a conservative estimate) became useless for feeding purposes due to fungal infections. These were sorted and so far as possible not used for feeding.

The unpalatability of the material used must therefore have been due to the substances inherent in the chestnuts, and on the basis of this experience point to the unsuitability of horse chestnuts as a poultry food.

Elderberries

Elderberries have been advocated as a supplementary food for poultry, fed either in the fresh state or dried for use in the winter as a scratch feed. It is obvious at the outset that owing to their high water content, no substantial quantity of concentrate feed is likely to be conserved by their use in a fresh condition since the extent of replacement is limited by the capacity of the fowl's digestive system. Moreover, it is doubtful whether it is worth drying the fruits in view of the excessive shrinkage.

Two species of elder are widely distributed in the British Isles, the common elder, *Sambucus nigra*, and to a much lesser extent the dwarf elder, *Sambucus ebulus*. Both species are credited with strong purgative properties, and cases of poisoning have been reported following the ingestion of berries from the dwarf elder.

Elderberries are known to contain a cyanogenetic glucoside, sambunigrin $C_{14}H_{17}NO_6$, which has been shown to be identical with the intermediate product mandelic nitrile glucoside (prunasin) formed in the hydrolysis of amygdalin. This would suggest that the use of elderberries as a stock feed involves some risk, more especially if included in a wet mash which is allowed to stand for any length of time before feeding, since enzymatic hydrolysis may proceed to the extent of liberating free hydrocyanic acid. Drying elderberries is said to reduce the toxicity.

Reference to the available literature indicates that the pharmacological effects are not very definite. Small quantities apparently purge animals and large intakes produce cardiac acceleration and severe emetic, cathartic and diuretic effects.

Outline of Experiment. Two groups each comprising six laying pullets were used for the feeding trial and housed in individual cages in a battery house. Both groups were fed a balanced mash at the daily rate of 4 oz. per bird. In addition, green unripe fruits and fully ripe black berries from the common elder were added in daily amounts of 1 oz. per bird for groups 1 and 2 respectively. At the commencement of the test the daily quota of berries were placed on the surface of the mash in order to obtain preliminary indications of their palatability. The ripe berries were relished by the birds, who ate them in preference to the mash, but the green fruits proved quite unpalatable and practically none was eaten. The fæcal portion of the excreta voided by the birds in group 1 became an intense purple colour twenty-four hours following the first feed and remained like this so long as the elderberries were fed. The physical consistency of the droppings and of the urine fraction was quite normal, however, and there were no indications of diarrhœa or diuresis.

After ten days the daily quantities of both forms of elderberries were crushed, mixed with the meal and fed as a wet mash. The ration containing ripe elderberries continued to be eaten readily, but the unpalatability of unripe berries was again marked, the mixed ration for group 2 being consumed reluctantly and part of the daily allowance invariably left in the troughs at the end of the day. This residue was mixed with the following day's food so that the effects of feeding material which had had favourable conditions for the hydrolysis of the glucoside could be observed. No harmful effects from either diet was noticed as a result of feeding the two rations for a period of thirty days. The birds in group 2 lost weight due to the subnormal food intake. Eggs which were laid by the experimental birds were broken and their contents examined. In every case these were described by independent co-operatives as perfectly normal in appearance and flavour.

It would seem from this limited test that no harmful effects to the health of laying birds or to the eggs they produce are likely to occur through the consumption of berries of the common elder (*Sambucus nigra*). Unripe berries are disliked by fowls and adversely affect the palatability of rations with which they are incorporated. Domestic poultry keepers with ready access to supplies may include ripe elderberries in the rations for their birds to provide variety and for condimental properties, but owing to their high water content it is obvious that no substantial saving of concentrate feed is likely to result from their use.

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MEGATECTONICS AND MICROTECTONICS

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TECTONICS is a branch of structural geology concerned with the deformational structure of the earth's crust as a whole and of its major and minor elements. It was Nicolaus Steno who in 1669 laid the foundation of the science of tectonics, but it was not until the beginning of the nineteenth century that tectonics assumed the character of an inductive science. During its earlier stages, tectonics was concerned only with the larger features such as folding, faulting and jointing, but with the advent of the microscope in geology, smaller features of rocks came to be studied. The pioneer of microscopical methods in petrology was H. C. Sorby, whose series of papers published between 1850 and 1860 opened up a new line of research both in the mineral composition and in the texture of rocks. After 1860 the attention of petrologists was concentrated mainly on the study of the composition of rocks, and their textural aspects were treated only from a descriptive point of view. The study of larger features of the earth's crust, however, proceeded with increasing vigour and scope.

During the last few decades remarkable progress in the field of tectonics has been made along two distinct lines of advance. One—through the study of the large features of rocks, such as schistosity, flow banding, jointing, etc. (megatectonics); the other—through the study of smaller features of rocks, such as the disposition of the constituent minerals, cleavage, schistosity, etc. (microtectonics).

Megatectonics deals with the large-scale deformations of the rocks and their resulting structures. These large-scale features vary in magnitude from large folds, faults and overthrusts to banding, foliation, schistosity and jointing. Broadly speaking, all these features can be subdivided into those depending on the fluid or plastic deformations of rock material (for example, magma) or rocks (flow or flowage structures), and those depending on the rigid deformation (fracture structures). The main object in magatectonics is to find the relation existing between the structures (which are observed) and the deformations which gave rise to these structures (which are inferred).

Flow and flowage structures are found in igneous and metamorphic rocks. In the former they were usually produced while the rock was still in a liquid or plastic state (primary flow structures), and in the latter while the rock was in the state of solid plasticity (secondary flow structures or flowage structures). In the primary flow structures the principal structural elements are: (*a*) flow lines, such as linear arrangement of unequidimensional crystals, clots, inclusions, etc.; and (*b*) flow layers (bands and schlieren).

Fracture structures are found in rigid rocks that have been subjected to deformations exceeding the limits of a plastic flow. In certain cases fractures can even be produced in material undergoing plastic deformation, such as viscous magma prior to its crystallization. The principal fracture structures are joints and faults. Joints can be classified into contraction (cooling, desiccation), expansion, dynamic, dynamo-plastic, and compression joints. The dynamo-plastic joints are related to flow structures. Such joints are usually found in plutonic igneous rocks and they are classified into cross-joints (normal to flow lineation or flow layers), longitudinal joints (parallel to flow lineation and normal to flow layers), and flow joints (parallel to flow layers).

Numerous geologists, among whom may be mentioned Van Hise, Leith, Mead, Heim and Becke, have added much to our knowledge of megatectonic features. It was Hans Cloos, however, who was first to attempt a systematic study of flow and fracture structures in plutonic and volcanic rocks. His principal object was to co-ordinate the various structures in such a way that a reasonable deduction could be made regarding the movements which gave rise to these structures. Since his original publication in 1921[1] this work has been aptly summed up by himself[2], by his brother Ernst Cloos[3] and by R. Balk[4].

As applied to igneous rocks, megatectonics was called igneous tectonics (granite-tectonics, if applied to granites). Probably the most interesting and also the most difficult problem of igneous tectonics is that of the study of batholiths and related intrusive forms. In this study the two fundamental problems—the origin and the mode of emplacement of the rock—are closely related, and it is here that the method of Cloos seems to be most applicable. Numerous works dealing with this problem have been recently published. Among them one may single out the publications of the Committee on Batholith Problems (bibliographies, abstracts of papers), the series of papers published in the report of the sixteenth session of the International Geological Congress (Washington, 1936, vol. 1), and the works of E. M. Anderson and J. E. Richey on ring-dykes, cone-sheets, etc.

Great progress has also been achieved in the field of microtectonics. Ever since the introduction of microscopical methods into petrology the study of rock textures has been an integral part of this science. Texture, as we know, embraces three aspects of the smaller features of rocks: (*a*) crystallinity—the degree of crystallization; (*b*) granularity—the size of crystals; and (*c*) fabric—the shape and arrangement of crystals. Microtectonics is mainly concerned with the fabric of rocks. Certain rocks, such as gneiss or schist, show clearly a definite parallel orientation of crystals, while other rocks, such as granite or basalt, as a rule do not show any marked orientation of crystals. The first class of rocks have, therefore, been called structurally anisotropic rocks, and the second class have been termed structurally isotropic rocks. The new method of study developed by Sander and Schmidt has revealed that many of the structurally isotropic rocks exhibit a certain hidden anisotropy in the arrangement of their component crystals. This new method, based on statistical interpretation of quantitative data, opened up a new line of development in petrology, and at the present time we can already distinguish *compositional petrology*—a science dealing with the mineralogical and chemical aspects of rocks—and *structural petrology*, a science dealing with the arrangement in space of minerals in rocks relative to megascopical characters and field position. The principal idea underlying structural petrology is that the arrangement of minerals in rocks is due to certain movements which have affected the rock either during or after its consolidation. Structural petrology has also been called petrofabrics, petromorphology or petrogeometry.

The modern development of structural petrology is due to Bruno Sander, who in 1911[5] showed that in certain structurally isotropic rocks, such as quartzite, the grains, if studied by optical methods, are definitely orientated, that is, their crystallographic lattices show a preferred orientation. This internal orientation, in contrast to the dimensional orientation of grains (which quartzite does not possess), was called the space-lattice or crystallographic orientation.

The original approximate statistical method of Sanders was eventually placed on a rigid quantitative basis by Becke[6] and Schmidt[7]. This new method consists of determining the position of the optic axis (or any other standard direction) of a mineral grain by means of Fedorov's universal stage. This vector is plotted on an equi-areal projection. The plane of projection is usually chosen to correspond with some megascopical feature of the rock. A number of grains being thus measured and plotted on the diagram provides an assemblage of dots. After counting the number of dots per unit area, equal density curves (similar to contour lines on maps) can then be drawn. The petrofabric diagram thus prepared gives a statistical picture of the orientation of certain selected vectors of crystal grains (usually optic axes of uniaxial crystals or cleavage planes of mica) in relation to some selected megascopical feature or features of the rock, for example, plane of schistosity, cleavage, bedding or geographical orientation.

The application of this method to the study of rock fabrics has been described in great detail by Sander[8] and Schmidt[9]. Sander's book is inordinately obscure, partly on account of the intrinsic difficulty of the subject, but mainly because of the cumbersome method of exposition. It is full of new terms for which there are no adequate English equivalents and of which the meanings are unfamiliar to ordinary petrologists. English versions of structural petrology have been published by E. B. Knopf and E. Ingerson[10] and H. W. Fairbairn[11]. These two books, which in certain respects are complementary to each other, embrace the whole field of structural petrology, and give a very clear picture, so far as the nature of the subject will allow, of this intricate science, besides providing a complete list of references. The book by Knopf and Ingerson is wider in its scope and more gradual in its approach, while the book by Fairbairn is more detailed in a restricted field.

A novice may at first be discouraged by the intricacies of structural petrology and especially by its terminology; he may even be tempted to reject the whole of it as a piece of elaborate nonsense, a mountain made out of a molehill. However, this attitude of prejudiced criticism is unwarranted; in the past, many attempts to introduce new methods in science have initially met with scant approval. It nevertheless remains true that the methods of structural petrology are far from simple and that the interpretation of the data obtained is often ambiguous.

The technique of structural petrology falls into four successive stages. The first stage, collection and slicing of orientated sections, is quite a simple process. The second stage, the measurement on the Fedorov's stage, is a rather laborious and time-consuming process. The third stage, the preparation of petrofabric diagrams, is comparatively simple. The fourth and last stage, the interpretation of petrofabric diagrams, is really a difficult process full of snags and pitfalls. The problem which has to be solved is the deduction from the symmetry and density areas of the diagram of the direction of the movements which determined this particular rock fabric, and this is not easy.

Several types of rock fabrics can be distinguished: isotropic, anisotropic, homogeneous, inhomogeneous, depositional, deformational, superimposed, etc. Fabrics are also distinguished by their symmetry and by the pattern of density belts and density areas. Especially complex is the problem of dynamo-metamorphosed rocks, not only because the original fabric has been modified, but also because the movements affecting rocks in their solid state are highly complex. The chief difficulty, however, is that the nature of the orientating process is still a matter of conjecture, since we have no precise knowledge as yet of the internal mechanism of solid flow.

The science of petrotectonics is still very young; it suffers from growing pains and from an infantile rash of terminology; its methods are laborious; its principles still very uncertain. To some, the application of petrotectonics to geology may appear like the construction of an elaborate gun for the purpose of killing a fly. Nevertheless, there are definite indications that petrotectonics may eventually become an important adjunct of petrology and geology. Here are a few selected examples of its application.

Macrotectonics has its limitations—structurally isotropic rocks like some granites and quartzites are 'dumb' until subjected to petrofabric analysis. Schistose metamorphic rocks do not always reveal the direction of movements which affected them during their metamorphism. A number of microtectonic investigations on these types of rocks have thrown important light on the problem of metamorphism. The investigation by F. Coles Phillips on the tectonics of Moine schists[12] furnishes an admirable example. The mineral orientation in the Moine schists supports the hypothesis that the Moine metamorphism is of pre-Torridonian age, that the movement which produced the metamorphism acted along approximately south-west and north-east lines, and that the later Caledonian movement acting on north-west and south-east lines had apparently little effect on the fabric. On the other hand, the petrofabric study of the so-called "Tarskavaig-Moine" series[13] suggests that their fabric is related to the south-east movement.

The application of petrotectonics to problems of economic character has also been attempted with marked success. G. W. Bain, for example, has shown that various properties of marble, such as the maximum and minimum strength, ease of sawing, ability to transmit light, etc., depend on the orientation of calcite crystals in the rock. By means of petrofabric analysis Bain was able to select the most favourable direction for sawing slabs of marble in the position most favourable for transmitting light[14].

These are only a few examples of the application of petrofabric analysis to scientific and applied problems. Many others are on record in spite of the comparatively short period during which the development of petrotectonics has been in progress. It is safe, therefore, to predict an assured success for both microtectonics and megatectonics, especially if these two branches are closely combined and their methods and terminology standardized and simplified.

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OBITUARIES

Dr. Aleš Hrdlička

BY the death of Dr. Aleš Hrdlička, which occurred in Washington, D.C., on September 5, at the age of seventy-four, the United States loses its leading exponent of physical anthropology, and anthropologists throughout the world a loyal and helpful friend. He was born of Czech parents who emigrated to the United States, carrying their young family with them, Aleš being the eldest of four boys.

Hrdlička's early life was a struggle, but by the age of twenty-two we find him a qualified homœopathic physician; later he took an allopathic degree. As soon as he qualified, we see him pursuing a practice which he continued with remarkable assiduity throughout life, that of observing, recording and publishing the interesting things he met with in his daily life. For Hrdlička, right from the beginning of his career to the end of it, was a quarryman, an assembler of building material, rather than a builder; he had a firm faith that master-builders would come along and find his materials of service. So it was when he became anthropologist to the Pathological Institute of the New York State Hospitals in 1896; he began measuring and recording the physical characters of the insane. At the beginning of the present century he passed from medicine to anthropology, becoming a member of the staff attached to the Department of Physical Anthropology in the U.S. National Museum, Washington. In 1910 he became curator of the Department and continued in that office until 1942; even then he did not retire but withdrew to the Smithsonian Institution, where he continued his labours until his sudden end.

During the period of his curatorship Hrdlička gathered personally, or acquired, representative collections of skulls and skeletons of men and anthropoids from their native regions in all parts of the world, aiming at giving each variety of mankind a full representation in the national museum, particularly those races which were, or have been, native to America. From time to time he issued reports on these collections, chiefly in publications connected with the museum. It was characteristic of him that he was never satisfied with reported discoveries of fossil man until he had examined the bones with his own eyes and measured them with his own callipers; no matter how out-of-the-way the site of discovery might be, in China, Java, Australia, Africa, Europe or South America, he made his way thither, held an inquest and returned with a documented report. The first of these reports appeared in 1913; the last and most valuable in 1930 (*Smithsonian Misc. Coll.*, vol. 83). He gave particular attention to discoveries of ancient man made in America, and seemed to take delight in reducing their antiquity to the lowest possible factor, and their type to that of the American Indian—in doing which his perspicacity was probably not much at fault.

Although Hrdlička grew up a fervid American, he retained a strong affection for the land of his birth, especially for its strong school of Czech anthropologists; they in turn were proud of him; on the occasion of his sixtieth birthday (1929), they celebrated the event by bringing out a Hrdlička volume of their publication *Anthropologie*. On the occasion of his seventieth birthday he was again honoured by having dedicated to him a volume of the *American Journal of Physical Anthropology*, to which colleagues at home and abroad contributed. It was fitting that this journal should celebrate the event, for it was Hrdlička's 'bairn'; he brought it into life in 1918, nourished and protected it until it grew into a hardy independence, and then handed it over to the Wistar Institute.

To aid in the celebration of this jubilee, Dr. D. Rubin de la Borbolla drew up a classified bibliography of Hrdlička's publications (*Boletin Bibliog. Anthropologia Americana*, vol. 2; 1939); between 1892 and 1938 they numbered 295. Clearly a review of such a literature does not fall within the compass of this notice; suffice to say that skull and brain, long bones and short, were subjected again and again to detailed report. In what may be called his field-work he centred his attention on the population of the United States, both living and extinct; on the changes produced by the arrival of millions of central Europeans in the first decade of the present century; the persistence of the British type in the descendants of early colonists ("Old Americans", 1925); more especially was his attention given to the American Indians, both to living representatives and to their predecessors, unearthed from ancient graves. No problem occupied his thoughts so continuously as that of the origin and homeland of this interesting race; his search for evidence turned his footsteps towards Alaska, and to the neighbouring region of Asia, which he finally concluded must be regarded as the cradle of the Amerind type.

In 1927 Hrdlička came to London to give the Huxley Lecture to the Royal Anthropological Institute and receive the Huxley Medal. In the spring of 1939 he again arrived in London, where he had arranged to give lectures at University College, and then to pass on to Russia, where important discoveries of fossil man had been reported. On leaving ship he had a sudden heart seizure (coronary thrombosis), lay for weeks in University College Hospital, made a surprisingly good recovery, gave his lectures and then made his pilgrimage to Russia.

In August of the present year I received from Hrdlička an autographed copy of what has proved to be his last book; it is entitled "Alaska Diary" (Cattell Press, Penn., 1943). Between 1926 and 1938 he made ten expeditions to Alaska, to study Eskimo and Indian, and to search for evidence bearing on the coming of the Amerinds; the "Diary" refers to the explorations made between 1926 and 1931. "These records", wrote Hrdlička, "have no pretense to any literary value, nor to any virtue aside from reality. They are just brief but faithful records of what befell or what was encountered by the writer."

With the "Alaska Diary" came a letter to me written by Dr. Hrdlička on June 23, some ten weeks before his sudden end. A few brief extracts from this letter will bring home to readers what kind of man he was better than anything I can tell them. "Future American histories of England", he said, "will be written in quite different, and much more honored and proud terms than were those of the past. May the English-Russian relations, also, continue and grow ever deeper. With those two realms going hand in hand, Europe will be effectually healed and restored, and so will much of the Old World; without it there would be misery and chaos." He took a rather pessimistic view of the future of his own subject: "I keep on, as formerly, and may yet see something accomplished even after the Alaska reports are off my shoulders. But conditions are rather disheartening; physical anthropology is in a deep trough. With anatomists weaned off from Anatomy and Anthropology, and the young would-be anthropologists impatient of sufficient preparation and so turning into flimsy statisticians, there are few chances in sight for a rejuvenation. . . . The basic reasons for the decline are plain enough. Those parts of anthropology that most appealed to the imagination and held most promise, have to a large extent been covered and failed to either satisfy or definitely solve matters. . . . But enough of this. If I have troubled you with it, it was with some faint hope that you might show me I am wrong, or getting old, or disgruntled, or something. As a matter of fact, I will the next minute be head-over-heels in happy and absorbing work on my old friend the tibia; and my head is full of plans and happy anticipations as to where I will go and whom to see after the war; and the seeing through of the three Alaska volumes is a real work of love." A. Keith.

Dr. A. H. Evans

Although it was published just before the opening of the present century, the volume on "Birds" by A. H. Evans, in Harmer and Shipley's "Cambridge Natural History", remains a well-used text-book. It is more readable than most text-books, it deals lightly and inadequately with structure (but then Beddard's work had appeared only the year before), and it concentrates upon the classification and particularly upon the appearance and habits of the birds themselves. This was almost to be expected, for Evans was essentially a field naturalist. In his schoolboy days at Durham, his interest in birds had been encouraged by Canon Tristram; at Cambridge, in the seventies of last century, it was confirmed by Alfred Newton; and the majority of his scientific contributions are records of observations in the field and faunal lists of areas he knew well.

Scotland gained much from Evans's frequent visits. To the fine series of vertebrate faunas of that country edited by Harvie-Brown and Buckley, he wrote, with the latter, "A Vertebrate Fauna of the Shetland Islands" (1899), and followed this with his own "Fauna of the Tweed Area" (1911); he also contributed occasional records to the *Annals of Scottish Natural History*. But his interests were not confined to local ornithology: with S. B. Wilson he described the birds of the Hawaiian Islands—"Aves Hawaiiensis" (1890–99); he wrote for the *Ibis* descriptions of his visits to South Africa and Australia with the British Association; he translated and annotated under the title "Turner on Birds" (1903) the rare sixteenth century "Avium Praecipuarum, quarum apud Plinium et Aristotelem mentio est, brevis & succincta historia" of William Turner, reputed father of British ornithology.

Evans took his share also in the conduct of ornithological affairs: from 1884 until 1889 he was recorder of the section "Aves" in the *Zoological Record*; from 1901 until 1912 he shared with P. L. Sclater the editorship of the *Ibis*; for some eight years he was guardian of Hickling and Horsey Broad for the owners; he was National Trust local secretary for Wicken Fen, and wrote an account of the Fen birds; he was president of the Berwickshire Naturalists' Club, and joint editor and vice-president of the British Ornithologists' Union.

These by no means exhaust the accomplishments of A. H. Evans, but they give the impression of a man of energy and activity, of learning and enthusiasm. Arthur Humble Evans was born in 1855, son of the vicar of Scremerston, Northumberland, and after graduating at Cambridge in 1879 (later he was awarded the Sc.D. degree) he continued there, teaching and tutoring in subjects which included English history and economics, for almost fifty years. When he was eighty-four years of age he published a "Flora of Cambridgeshire" and shortly before paid his last visit to a meeting of the Royal Society of Edinburgh. He died on March 28, 1943, having passed by little more than a month the eighty-eighth anniversary of his birth. James Ritchie.

Prof. F. Bacon

Engineers in many parts of the world who received their training at the University College of Swansea under Prof. Frederic Bacon, and the many others who came in contact with him through his varied activities, will learn with great regret of his sudden death, which occurred at Earlestone Common, near Newbury, on August 23.

Prof. Bacon, who was sixty-two, was the son of the Rev. J. M. Bacon, the scientific aeronaut. His first practical experience was obtained with Plenty and Sons, engineers, at Newbury. In 1899 he went to Trinity College, Cambridge, where he won an exhibition and studied under the late Sir Alfred Ewing. In 1902 he obtained first-class honours in the Mechanical Science Tripos. After further practical experience with Yarrow and Co. at Poplar and the British Westinghouse Electrical and Manufacturing Co. at Trafford Park, Manchester, he was appointed in 1905 to the teaching staff at the Royal Naval College, Greenwich, and later he also gave special lectures on the photo-microstructure of metals at University College, London.

In 1913 he was appointed professor of engineering in the University College of South Wales and Monmouthshire at Cardiff, and on the outbreak of the War of 1914–18 he organized the facilities of the Engineering Department for the manufacture of precision gauges required for shell manufacture. Later he served as lieutenant R.N.V.R. attached to H.M.S. *Vernon* in connexion with the design and development of paravanes, etc. Afterwards he was transferred to the Anti-Submarine Division of the Admiralty as technical expert in the experimental development of anti-mine and anti-submarine devices. In 1920 the chair of engineering was created in the University College of Swansea, and Prof. Bacon was appointed to this position, which he held until his death.

Prof. Bacon was a born research worker and investigated a number of problems in connexion with fuel economy, dust prevention, wind pressures, etc., but the work for which he will be best known was on fatigue, cracking and fracture of various materials. The most important papers on this work were: "Fatigue Stresses with special reference to the Breakage of Rolls" (*Proc. South Wales Inst. of Eng.*, 1930); "Fatigue and Corrosion Fatigue with Special Reference to Service Breakages" (*Proc. Inst. Mech. Eng.*, 1933), for which he was awarded the T. Bernard Hall Prize; "The Relation of Fatigue to Modern Engine Design" (*Trans. N.E. Coast Inst. Eng. and Ship.*, 1935). This last paper was in conjunction with two other engineers and was awarded the M. C. James Gold Medal.

A very large number of other papers and lectures on fatigue and allied problems were given to various engineering and technical societies, both in Great Britain and Germany; his last investigation, undertaken at the request of a Government Department, was on the notch sensitivity of certain materials under cyclic stress.

Prof. Bacon devoted much time to the leading engineering institutions; he took a prominent part in the formation of the South Wales branch of the Institution of Mechanical Engineers, was its secretary for several years and became its chairman. He was also a past president of the South Wales Institute of Engineers and served on the committees of the local sections of the Institutions of Civil and Electrical Engineers.

Although of a naturally reserved disposition, those who knew him best will remember his charm of manner as well as the unstinting interest he took in his students.

WE regret to announce the following deaths:

Prof. Frederick Barry, professor of the history of science in Columbia University, aged sixty-seven.

Prof. A. D. Bevan, professor of surgery in the University of Chicago, on June 10, aged eighty-two.

Mr. P. J. Haler, M.B.E., principal of the South-East Essex Technical College, on September 13, aged sixty-seven.

Prof. R. A. von Muttkowski, professor of biology in the University of Detroit, on April 15, aged fifty-six.

Mr. Colin F. Symington, of the Malayan Forestry Service, on September 9.

Mr. C. C. Willoughby, emeritus director of the Peabody Museum of Harvard University, on April 21, aged eighty-five.

NEWS and VIEWS

International Air Transport

A BROADSHEET (No. 208) entitled "International Air Transport", which P E P (Political and Economic Planning) has put forward as a contribution to the widespread discussions now taking place, is concerned with the extent to which the organization of international transport can be entrusted to international bodies. It reaches the main conclusion that there is a strong case for setting up an International Board for Air Navigation and for international public corporations for the operation of certain international services. A start should be made with corporations for Europe and for the North and South Atlantic. It is suggested that out of the large-scale emergency air-services which the United Nations will need to operate in the immediate post-war years to the shattered areas, distributing food and medical supplies, and carrying officials, medical men and technicians, a European airways corporation could naturally grow. Discussing future prospects, the broadsheet considers it certain that air transport will carry more and more international passenger traffic, cost and speed being two of the determinants. Much pre-war ocean travel in the first and cabin classes will be shifted into the air. Air mail is also likely to become more and more important.

The spirit of international co-operation will be essential if the opportunities are to be realized. Co-operation will be essential if air transport is not to continue a creature of nationalism, hampered by lack of freedom of the air and artificially stimulated by subsidies. Co-operation will be necessary to secure common technical standards. Unlimited competition among commercial operators is not likely to be tolerable, pooling agreements to mitigate the waste of competition will be insufficient, and some measure of international co-operation will be essential. This, however, involves reversal of many of the policies pursued in the past. The broadsheet visualizes a system of collective security in which an international police force plays a part and an international board for air navigation, following the precedent of the International Commission for Air Navigation established under the League of Nations. The possibilities of commercial co-operation have already been demonstrated by the International Air Traffic Association.

Reconstruction of the Social Order

IN a memorandum on the reconstruction of the social order, entitled "Peace and the Threefold Commonwealth" (London: Rudolf Steiner Publishing Co.; New York: Anthroposophic Press, 1943, 1s.), Mr. T. G. Jones gives an outline of the ideas of Dr. Rudolf Steiner as indicated more particularly in his books "The Threefold Commonwealth", "The Social Future and World Economy". The human social order is a threefold structure consisting of a body economic, the sphere of the State and a spiritual or cultural life. These are at present so entangled that none of them can develop fully on its own proper basis. If each of these parts of the social order is allowed to develop on its own proper ground it will bear rich fruit for the healing of social disease, and co-operation of the three parts to establish a threefold articulated healthy social order will then be possible. For this purpose economic associations for each industry and a Central Economic Council are suggested, and while the main task of Parliament would be to formulate and administer the code of rights, the economic associations would contribute from their surpluses to the economic support of the spiritual or cultural institutions.

The two main proposals in the memorandum are the allocation of a fair share of work between the several industries under the code of rights by determining mutually fair hours of labour, and the determination by the Central Economic Council of the total production of any one kind of goods and services. Each association would receive for its output a price comprising what it required to satisfy that part of the total needs of consumption for which it was responsible. To achieve this it would be necessary to fix a standard economic value as a unit of money, and each association would sell its product at a price representing the economic value or "organised labour value", a kind of quotient of work done for the elaboration of a natural product and the organization and division of labour by the human spirit. By distributing these values among the manual, clerical and supervising workers belonging to the association, again according to the consumption needs for which the association is responsible, among the lenders of capital and, through the Central Economic Council, among those for whom the workers in the industry could be held communally responsible in proportion to their needs, it is suggested the root causes of conflict between employers and employed would be eradicated. Other suggestions relate to the provision of funds for new or extended economic enterprise and the issue of money so as to ensure that it is a true medium of exchange and no more, and to prevent the money in circulation exceeding the economic values created.

The Kentucky Dam, Power House and Lock

THIS is a project of the Tennessee Valley Authority, and owing to the proximity of the site to the secondary zone of disturbance of the New Madrid earthquake of 1812, all structures forming part of the main dam were proportioned to resist seismic disturbances (*Earthquake Notes*, 14, Nos. 3 and 4; June 1943). The following seismic loadings were adopted: for mass structures of great rigidity an equivalent inertia force equal to 0·05 g. and for less rigid structures an inertia force varying from 0·06 g. to 0·10 g., based upon rational calculations of the dynamic action of the structure. The seismic increase in reservoir pressures was calculated by the Westergaard formula, using an earthquake acceleration of 0·05 g. For the two large retaining walls at the end of the earth embankment at each side of the river, special investigations were undertaken to establish the proper seismic loading. An extensive programme of shaking-table tests was conducted at Leland Stanford University by Prof. L. S. Jacobsen. On the basis of these tests an equivalent inertia force of 0·18 g. was applied to the conventional Coulomb wedge, the point of application being about 0·60 the height above the base. For structures sustaining hydraulic loads, the increase in overturning moment due to seismic effect was only 7 per cent, while the corresponding increase for structures such as retaining walls carrying earth loads was of the order of 35 per cent. Maps recently sent out by the State Geologist of the State of Missouri indicate large anomalies in both gravity and vertical magnetic intensity in Stoddard County, the locality of the great New Madrid earthquake of 1811. Whether there is any significance in the coincidence is not established, but the seismic precautions mentioned above do not appear to lack wisdom.

The Gas Industry in Great Britain

A BROADSHEET entitled "The Gas Industry in War-Time" (No. 210), which has been issued by Political and Economic Planning, brings up to date the report issued by P E P just before the War. It gives a concise factual account of the structure of the industry, including a note on the work of the Gas Research Board, to which gas undertakings representing 76 per cent of the gas output of Great Britain are now allied. Civil defence measures, man-power, the effect of the War on the distribution of demand, prices, fuel economy, coal supplies, gas quality, coke-oven gas, and trends in regard to coke and by-products are briefly surveyed. In regard to the last, six committees have been set up to investigate specific problems related to the replacement of imported by home-produced fuels, and to the most effective utilization of the latter in war-time, in particular the possibility of increasing the amount of liquid products—tar, creosote, benzene, toluene, etc.—obtained by high-temperature carbonization in gas-works and coke-ovens. Considerable progress has been made in the use of creosote pitch as a boiler and furnace fuel, although its high viscosity involves certain difficulties.

Public Health in Uruguay

IN a recent paper (*Bol. Of. San. Panamericana*, 22, 394; 1943), Dr. J. C. Mussio Fournier, formerly Minister of Public Health in Uruguay, gives the following account of public health in his country during the period 1938–42: (1) extension of preventive services; (2) better distribution of public health appropriations; (3) considerable increase of hospital beds and in hospital construction; (4) intensification of the campaign against tuberculosis. The Health Division, Bureau of Health Examinations and departments of vital statistics, industrial hygiene and school prevention have been very active and the campaign against diphtheria has progressed. The appropriation for the Ministry of Health has increased 32 per cent. The present Government has spent 1,847,500 pesos on tuberculosis treatment, 590,000 for mental patients, 3,170,000 for the Clinical Hospital, 2,774,000 for improvements in Montevideo and 1,675,000 for rural construction. In 1937 Uruguay had only 1,055 beds for tuberculosis, a number far below present needs, as there are about 2,400 deaths annually from this cause in that country. To-day, however, Uruguay leads all Latin-American countries in the number of beds devoted to that disease.

T. K. Sidey Summer-time Award

THE Royal Society of New Zealand invites applications for the T. K. Sidey Summer-time Award, consisting of a bronze medal and prize of £100, given for contributions to human knowledge by original scientific research in any of the following subjects: (1) the study of light, visible and invisible, and other solar radiations in relation to human welfare; (2) the general study of radiations of every kind. Such scientific research shall not be deemed to be limited to research in medical science. Primarily the award is to be made to a New Zealander or for work carried out in New Zealand, but the Council of the Society is at liberty to vary conditions and subject. Applicants for the award may submit either theses specially prepared or copies of published works. Applications should reach the Secretary, Royal Society of New Zealand, Victoria University College, Wellington, New Zealand, not later than January 31, 1944.

Mathematical Tables and Aids to Computation

ON January 1, 1943, there appeared the first number of a new journal, entitled *Mathematical Tables and Aids to Computation*. It is published by the National Research Council (Washington, U.S.A.), and is to appear quarterly. The subscription is three dollars a year. The editor is Prof. R. C. Archibald, chairman of the National Research Council's Committee on Mathematical Tables and Aids to Computation, to whose retirement from the chair of mathematics at Brown University reference was made in NATURE of August 21, p. 211. Some of the articles are bibliographical, such as one in the second number (April 1943) dealing with the various trigonometric tables with radian arguments. A valuable feature is a section on the description and location of unpublished tables. This, it is hoped, will not only help research workers, but also prevent useless duplication of costly effort. There is a section for queries and replies to them. The longest article in the first number is a list of eighty-eight recent tables, with reviews of the last fourteen and references to other journals where reviews of the first seventy-four can be found.

Earthquakes during June

DURING June 1943 thirteen earthquakes were registered strongly by the seismographs at Kew Observatory. The strongest of these was on June 9. The shock began registration with *iP* at 03h. 19m. 56s. U.T. and attained a maximum amplitude of 420 μ at 04h. 09m. 55s. U.T. on the vertical component at Kew. It is estimated to have come from an epicentre some 10,700 km. distant. This earthquake was registered at Stonyhurst at 03h. 20m. 40s. U.T., beginning with *eP*. Three shocks were registered at Kew and Stonyhurst on June 13. The first was by far the greatest. It recorded *iP* on all three components at Kew at 05h. 23m. 59s. U.T., apparently coming from an epicentre some 9,100 km. distant. The first recording was compressional and the maximum amplitude at Kew was 270 μ at 06h. 00m. 45s. U.T. on the N component. Stonyhurst recorded the shock at 05h. 24m. 10s. U.T. The other two shocks on June 13 were probably aftershocks from the same epicentre. The German News Agency reported a shock on June 12, recorded at Württemberg Observatory at 6.22 a.m., and believed to have taken place in the Eastern Alps, but this movement was not significantly recorded at Kew.

The United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the epicentres of three earthquakes in mid-June on the basis of instrumental reports received from observatories in America, Australia and New Zealand. The first was on June 13 at 5h. 11m. 44s. U.T. from an epicentre near 43° N., 142° E., which is near the central peak of Hokkaido Island, one of the Japanese Islands. The depth of focus was normal. The second was on June 14. The earthquake took place at 13h. 23m. 34s. U.T. at an epicentre near latitude 28·5° N., longitude 112° W., which is in the Gulf of California just south of the mouth of the Sonora River. The depth of focus was normal. The third earthquake was on June 15, occurring at 18h. 21·7m. U.T. from an epicentre near latitude 14·5° N., longitude 93° W., which is in the Pacific Ocean on the 100-fathom line west of the junction between Chiapas and Guatemala in Central America. This earthquake also had a normal depth of focus. The earthquake of June 20 was recorded at Kew and Stonyhurst. At Kew it recorded with *iP* at 15h. 38m. 04s. U.T. from an epicentre some 2,600 km. distant. It attained a maximum amplitude at Kew of 98 μ at 15h. 48m. 36s. U.T. on the vertical component. All interpretations and calculations are provisional.

Gift by Prof. T. D. A. Cockerell

PROF. T. D. A. COCKERELL, emeritus professor of zoology in the University of Colorado, will be remembered by many readers of NATURE as a frequent contributor of communications on biological topics. So long ago as 1920, he produced a useful and distinctive book entitled "Zoölogy: A Text-book for Colleges and Universities", which was reviewed in NATURE of December 23, 1920, p. 529. This was not an ordinary text-book of its time, for it catered for the needs of those who were not intending to specialize in zoology, and so included chapters on social life, the evolution of man, eugenics and sociology from the biologist's point of view. In its general approach it was perhaps in advance of much of the thought of its day. The book was re-issued from time to time, and Prof. Cockerell has now had prepared, at his own expense, an impression of a thousand copies which have been presented to the Board of Education in Great Britain. The gift will be much appreciated, and the volumes will no doubt contribute in no small measure to the growth of that biological outlook on man and his affairs which are necessary for the future peace of the world.

The Night Sky in October

FULL moon occurs on October 13d. 13h. 23m. U.T., and new moon on October 27d. 15h. 23m. The following conjunctions with the moon take place: Oct. 18d. 04h., Mars 4° N.; Oct. 18d. 14h., Saturn 2° N.; Oct. 23d. 07h., Jupiter 0·2° S.; Oct. 25d. 03h., Venus 4° S. The following occultations of stars brighter than magnitude 6 take place: Oct. 3d. 18h. 01·0m., 49 Lib(*D*); Oct. 8d. 18h. 43·5m., 19 Cap(*D*); Oct. 15d. 02h. 59·2m., μ Cet(*D*); Oct. 15d. 04h. 10·3m., μ Cet(*R*); Oct. 15d. 22h. 17·4m., *f* Tau(*D*); Oct. 15d. 22h. 58·6m., *f* Tau(*R*); Oct. 17d. 01h. 26·5m., γ Tau(*R*). The times are given for Greenwich and *D* and *R* refer to disappearance and reappearance respectively. Mercury attains its greatest western elongation on Oct. 10. It is a morning star, and at the beginning of the month rises at 5h., an hour before sunrise. At the end of the month it rises at 6h. 15m., 35 minutes before sunrise. Venus is a morning star and rises at 3h. 17m. and 2h. 37m. at the beginning and end of the month respectively. The planet attains its greatest brilliancy on Oct. 13. Mars can be seen in the constellation of Taurus in the evening and sets at 12h. 32m. at the beginning of the month and at 11h. 05m. at the end of the month. On Oct. 28 the planet is stationary. Jupiter, in the constellation of Leo, is a morning star, rising at 1h. 30m. at the beginning of the month and at midnight at the end of the month. Saturn can be seen close to Mars and is stationary on Oct. 9. At the beginning and end of the month the planet sets at 12h. 40m. and 11h. 10m. respectively. Times are given approximately for the latitude of Greenwich. The Orionid meteor shower is due about Oct. 18–21. The radiant is close to the star ν Orionis.

Announcements

PROF. EDWARD HINDLE, regius professor of zoology in the University of Glasgow, has been appointed scientific director of the Zoological Society of London.

THE following appointments and promotions in the Colonial Service have recently been made: J. D. Yeld, agricultural officer, Northern Rhodesia; T. Threlkeld (veterinary officer, Jamaica), senior veterinary officer, Jamaica.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

James Prescott Joule and the Unit of Energy

A CENTURY has passed since Joule read his paper on the relation between heat and work at the meeting of the British Association at Cork on August 26, 1843. It is unfortunate that a difference of opinion has arisen about the correct pronunciation of his name and also of the word *joule* used to denote a unit of energy (ten million ergs or one Newton-metre). The "Oxford English Dictionary" gives *dzaul* as the pronunciation of the unit, where *au* represents the sound in the word *loud*. In "Webster's New International Dictionary" (1911) is found the statement: "The proper name is pronounced *joul* (*ou* as in *out*) and this is the correct pronunciation for the unit; but the incorrect *jo͞ol* [*o͞o* as in *fo͞od*] is very common especially in the United States." In "Chambers's Technical Dictionary" (first published 1940) we find the contradictory statements

joule, jool (Phys.). A unit of energy equal to 10^7 ergs.

(Named after F. [*sic*] P. Joule, 1918–89; name pronounced jowl.)

From boyhood I have been accustomed to the pronunciation *jool*, and was pleased to receive support for this from my colleague Sir D'Arcy Thompson, whose memories of the Royal Society of Edinburgh go back to the days of Lord Kelvin. He consulted Sir John Stopford, vice-chancellor of the University of Manchester, who replied on August 17, 1943: "I believe it is JOOLE and I never heard Jowle until comparatively recently when I think it came from the South. The family I knew in my youth insisted upon JOOLE and I think they were descendants". My friend Dr. George Green, of the University of Glasgow, was at one time private secretary to Lord Kelvin, and he writes (August 22, 1943): "The name Joule should rhyme with 'rule'. This is how Lord Kelvin pronounced it, and this has always been the pronunciation in Glasgow, as far as I can remember—by Prof. Gray (Senior) for instance." Prof. G. W. O. Howe (August 25, 1943) writes: "Some years ago I was troubled by the same question and I made enquiries—also in Manchester—and came to the conclusion that Joule and his relatives always pronounced the name 'joole'. I was pleased to learn this as I had always so pronounced it and regarded 'jowl' as a hideous mispronunciation".

I venture to suggest that the pronunciation 'Jowle' may have originated in Salford through the sardonic humour of local workpeople who, having in mind such an expression as 'cheek by jowl', spoke of 'Jowle's brewery'.

The pronunciation *joole* for the unit of energy (the joule) in the M.K.S. system of units has the advantage that it is immediately applicable in the French language—compare the words *boule* and *jour*. I am told by Mr. W. D. Oliphant, to whom I am indebted for much assistance in this question, that in the War of 1914–18 a French submarine (lost in the Dardanelles) was named *Joule*.

H. S. ALLEN.

Physical Laboratory,
University of St. Andrews.

Seed Selection in Forestry

I HAVE been expecting to see a protest from one of our leading plant geneticists against the casual treatment of the subject of genetical research in the White Paper on Post-War Forest Policy (Cmd. 6447), but as it has not drawn their fire, I must presume that it has not come to their notice, and so venture to write as a forester with limited experience in this field. Right at the end of the section on "Ancillary Research", among the "Miscellaneous Investigations" of paragraph 383, is a bald reference to "work on the origin of seed, i.e., the effect of selecting seed of a given species from different parts of its natural range (a large number of comparative plots have been established in different parts of Great Britain)". The only other reference is in paragraph 395, where research on tree breeding is dismissed as insufficiently urgent to justify taking it up among the major projects after the War.

Now the White Paper envisages for Great Britain the afforestation by planting or sowing of some three million acres of bare land, and the effective management, which must also involve extensive planting, of a further two million. The trees planted out now will remain from, say, 40–120 years; we have complete control of the choice of stock to be used, but no possibility whatever of remedying during those long periods any mistake made in its genetic suitability. One might well marvel that, in view of the classical disastrous errors made on the Continent and the almost complete ignorance of the subject for the exceptionally varied conditions of Britain itself, this field was not made one of the major subjects of research from the very initiation of national forestry after the War. That it should continue to be viewed as a minor sideline is, to say the least, astonishing. There are often good grounds for suspecting that the genetic constitution of the stock is primarily responsible for the badness of the inferior tree crops so often met with in most parts of Great Britain; yet the collection and distribution of tree seed continues to be almost entirely haphazard. Surely it would be worth waiting even several years to make sure of procuring the best strains available for each district. Helpful as existing experiments on the differences between seed from different (again ill-defined) sources may be, the scale and execution is utterly inadequate to the importance of the subject.

An immediate step called for doubly urgently at the beginning of the present War was the selection and preservation of suitable stands on an adequate scale for seed production, but this is only one of the steps needed. It is almost superfluous to point to the example set us by several of the smaller countries of Europe in this matter, including some where planting is a far less common practice than with us.

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Spray-Dried Rose Hip Powder

THE increasing interest that is being taken in natural sources of vitamin C in general, and in the extraction of this vitamin from rose hips in particular, suggests that some observations made by us on the production of a spray-dried rose hip powder may be of interest. In the autumn of 1942 it was desired to prepare a concentrated rose hip extract with high ascorbic acid potency, but a vacuum-evaporated extract proved to be somewhat unstable. In view of our previous success with the spray-drying of apples, plums and black currants, it was decided to apply the earlier technique to rose hips.

An extract of the fruit was made by boiling the milled hips with twice their weight of water for half an hour, the liquor being removed by hydraulic pressure. By this means a thick pectinous fluid was obtained, which on concentration gave a material with the following analysis :

Specific gravity ..	1·095
Ascorbic acid ..	219 mgm./100 gm.

No attempt was made to remove the pectic substances by enzyme action as the presence of pectin had been found, in previous work, both to aid the process of spray-drying and to assist in the retention of ascorbic acid. The concentrate was spray-dried in a semi-commercial Kestner machine. A smooth, free-flowing powder of very fine texture was produced without the slightest difficulty. Using an air outlet temperature of 85–90° C., a powder was collected which retained 5·1 per cent of moisture and 979 mgm. ascorbic acid/100 gm.—showing a negligible loss due to the drying process.

The powder was gas-packed in cans and after storage at room temperature for three months showed a loss of not more than 3 per cent in the ascorbic acid value. (The ascorbic acid determinations were carried out by the method of Harris and Olliver[1] and checked by the potentiometric method of Harris, Mapson and Wang[2].)

The hips used for the experiment were of poor quality, and very much higher figures should be obtainable with better samples of raw materials. It would appear that the production of such a powder might enable ascorbic acid to be added to certain solid food materials in this form.

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Alleged Vitamin K Activity of Phthalic Acid

THE fact that several naphthoquinone derivatives and some related substances can replace the natural K-vitamins is most easily explained by assuming either : (1) that the prothrombinogenesis *per se* can be effected by several compounds, or (2) that the various vitamin K active substances are converted in the body into the same prothrombinogenic compound, which may be a substituted naphthoquinone.

Recently[1] it has been claimed that the vitamin K activity depends upon an oxidative biodecomposition of the suitably substituted naphthoquinones into phthalic acid. This compound was said to possess a perceptible although slight vitamin K activity, and the vitamin K activity of the 'diethyl ether' of phthalic acid was said to be high.

Potassium acid phthalate and diethyl phthalate have been tested for vitamin K activity in my laboratory. The method used was a modification of that of Dam and Glavind[2]; and the doses, fed to vitamin K-deficient chicks weighing about 300 gm., were 1, 10 and 100 mgm. potassium acid phthalate or 23 mgm. diethyl phthalate. The response was entirely negative. Under the same conditions menadione gave a considerable response in doses of 0·002–0·004 mgm.

Phthalic acid or diethyl phthalate can, therefore, not be the compounds which are responsible for the prothrombinogenic effect of naphthoquinones having vitamin K activity.

Whether substances showing vitamin K activity are converted by the animal body to phthalic acid is yet another question. At present, however, there seems to be little experimental evidence to support such a view.

This investigation was aided by the Josiah Macy, Jr., Foundation.

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Purification of Mares' Serum Gonadotrophin

IN 1941, Rimington and Rowlands[1] described the production from pregnant mares' serum of a concentrate having gonadotrophic activity of 150–625 I.U./mgm., depending upon the activity of the serum, and equivalent, in the mean, to 73 per cent of the activity of the starting material. The process is suitable for large-scale operation. Slight modifications, details of which will be published shortly, have resulted in about a two-fold increase in the activity of the product at this stage, without affecting the yield.

Further purification has been effected by fractional alcohol precipitation at varying *p*H. Comparatively inert material, to the extent of 80–90 per cent by weight, can be precipitated by 50 per cent alcohol over a *p*H range of 5·0 and 1·5; in more acid mixtures precipitation did not occur or was incomplete. The active material separates on increasing the alcohol concentration of the supernatant fluid to 66 per cent. The temperature was maintained at 0° C. throughout ; no loss of activity occurred. The lower the *p*H of the mixture, to the limiting value of *p*H 1·5, the greater is the activity of the product. At *p*H 1·5 the products have assayed 11,750–12,500 I.U./mgm. and contain approximately 16 per cent hexose (orcinol method) and 8 per cent glucosamine. It was found that, whereas the hexose content of the products prepared at *p*H 1·5 and *p*H 5·0 respectively are in the ratio of 2 : 1, the ratio of their gonadotrophic activities is 12 : 1.

Experiments are proceeding to elucidate the chemical composition, electrophoretic behaviour and sedimentation velocity of our most highly purified preparations.

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Silicates of the Perovskite Type of Structure

THE mineral perovskite, $CaO.TiO_2$, is known as the prototype for the crystal structures of a large group of compounds[1]; the unit cell is essentially cubic, but for most members distorted to various degrees in an orthorhombic, monoclinic, or triclinic manner. Hitherto the composition ABX_3 has been regarded as characteristic of this structure, where A and B are metal ions of the total valency six, and X is usually oxygen.

We wish to report that certain silicates also possess the perovskite type of structure, a fact which is believed to be new and of considerable consequence. They are merwinite, $3CaO.MgO.2SiO_2$ and its manganese analogue, $3CaO.MnO.2SiO_2$.

During the examination of basic electric arc furnace slags we found that a certain type differed in its X-ray diffraction pattern from the rest, and was closely related to perovskite. In contrast to normal finishing slags, this type had failed to 'fall' (that is, to disintegrate on cooling at 675° C through the transformation from β to γ-dicalcium silicate). The phases normally observed in falling slags, γ-$2CaO.SiO_2$, $3CaO.SiO_2$, CaF_2 and MgO, were absent from these samples; the absence of free magnesia in particular indicated that MgO would form an integral part of the new phase. The compound was identified as merwinite, dealing with which several publications have appeared recently[2,3].

The 'manganese-merwinite' was found by us by X-rays and is, to our knowledge, a new compound. It was obtained unexpectedly by firing 80 per cent β-$2CaO.SiO_2$ with 20 per cent $2MnO.SiO_2$ at 1,300° C. in hydrogen and cooling rapidly, in an attempt to determine whether a partial solid solution exists between these two compounds. The X-ray pattern of the fired product was the same as that of merwinite, but of a wider spacing. The composition of this phase is approximately $3CaO.MnO.2SiO_2$. The large Mn^{++} ion possesses a radius nearly midway between that of Mg^{++} and calcium ($Ca^{++} = 1{\cdot}06$, $Mn^{++} = 0{\cdot}91$, $Mg^{++} = 0{\cdot}78$ A.), so that it may also partly replace calcium, as is known, for example, in the garnets. The new compound attains a special significance, as it is liable to be produced in certain basic oxidizing slags.

The pattern of merwinite corresponds to a pseudo-cubic, but complex and somewhat distorted, unit cell, as revealed by the splitting of the main cubic lines into groups, and the appearance of additional reflexions. The lattice spacing of the ideal cube of merwinite is 3·76 A. against 3·81 A. for perovskite.

The fact of merwinite showing this type of structure seems important for the following reasons:

(1) The perovskite type of structure is highly accommodating in composition, and permits of a wide variation of relative and absolute ionic radii, without breaking down.

(2) No silicate of this structure type has, to our knowledge, been reported: a direct substitution in $CaO.TiO_2$ of Ti^{4+} by the small Si^{4+} ions (ionic radii 0·64 and 0·39 A.) would render the structure unstable (wollastonite $CaO.SiO_2$ differs entirely), but it becomes possible, if simultaneously some Ca^{++} ions are replaced by the smaller Mg^{++} or Mn^{++} ions and certain lattice-positions are vacated.

(3) The structure is not, as usually regarded, tied to the formula ABX_3. Further evidence for this is afforded by perovskite itself. In the lime-titania binary system it was observed that $CaO.TiO_2$ and $3CaO.2TiO_2$ are isomorphous, except for a slight lattice-distortion, a generally permitted feature of the perovskite family. Apparently a series of solid solutions exists of CaO in $CaO.TiO_2$, extending beyond 60 molecular per cent CaO and modifying, but not destroying, the lattice. The mechanism is again one of omission of ions from the lattice. Mg^{++} ions are also readily taken into solution. Thus, contrary to accepted ideas, the perovskite type of compounds may vary over a wide range of compositions from ABO_3 in the direction of and including A_2BO_4, covering merwinite if Ca^{++} and Mg^{++} are classed together.

The perovskite lattice consists essentially of a simple cubic lattice of Ca-ions with O-ions in the face-centres and Ti in the centre of the cube. The number of atoms per unit cell is $N = 5$. For merwinite, assuming the measured spacing 3·76 A., density 3·15 (value for natural mineral), mean atomic weight of $Ca_3MgSi_2O_8 = 23{\cdot}49$, calculation gives N in the order of 4·3 atoms, in close approach to perovskite, but again indicating a more open lattice (vacant positions). It is necessary to add that the actual merwinite unit cell will consist of a multiple of perovskite cells. Nine such cells stacked in a pseudo-cube, and containing three molecules (42 atoms) would form the smallest unit able to take an integral number of merwinite molecules and will constitute a probable true unit cell. The detailed structure remains to be analysed. However, postulating the basic SiO_4 tetrahedral groups, as for all silicates[4], a line of approach lies in modifying the known perovskite lattice so as to accommodate these groups.

The chief practical point arising, apart from the existence of the two compounds as such, is probably the high tolerance factor of the perovskite type of structure, which implies that merwinite is able to take into solution a variety of radicals from contacting substances (slag, steel), provided the atomic sizes and valencies permit. In basic electric arc furnace slags, we have frequently observed variations in line-intensities and spacings of the merwinite pattern, which no doubt correspond to partial replacements, each involving a modification, but not a breakdown of the lattice. Merwinite may be considered as possessing a 'sponge-like structure' in which CaO, MgO, MnO, SiO_2, TiO_2 can be replaced within limits. Its influence on the properties of the slag is pronounced; the non-falling and hard constitution of slags found to be merwinite is one example.

We have observed by X-rays the presence of merwinite or its isomorphs not only in basic electric arc furnace oxidizing and finishing slags, but also in basic open hearth slags.

This investigation forms part of a more comprehensive research into the constitution of steel works' slags and refractories.

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Colour Microscopy in Ultra-Violet Rays

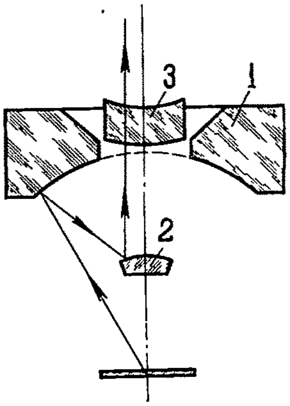
ULTRA-VIOLET microscopy has important advantages in the study of different microscopic objects[1]. In 1939 I suggested a new method of microscopy in ultra-violet rays, making use of selective absorption or reflexion of microscopic objects in the ultra-violet[2].

The first version of this method—the photographic one—is the following: a colour photomicrograph of a non-coloured object is taken in a way similar to that used in ordinary three-colour photography. The only difference is that to take the photograph three wave-lengths in the ultra-violet are used, whereas the reproduction of the three separation negatives is made with the help of the three primary colours in the visual, namely, red, green, blue. The hues of the details of such colour photomicrographs are given by the difference of densities of negatives taken in the ultra-violet, hence by the ultra-violet spectral absorption or reflexion curves for the corresponding parts of the object. The colours obtained are, of course, conventional; the image of the object is, so to say, shifted on the wave-length scale from the ultra-violet into the visible.

Some colour photographs taken in the way described are reproduced elsewhere[2,3]; they are illustrative of the possible applications of the method.

It is of great interest to construct instruments for direct colour vision in the ultra-violet without the use of the photographic methods. I have recently worked out and described two similar versions of a method for visual colour microscopy in the ultra-violet[1,4]. In the first, one each of the three ultra-violet wave-lengths excites one of the three primary colours on a fluorescent screen covered with a mixture of three substances, differing in the colour of their fluorescence, as well as in their excitation regions. In the second version, two rotating disks with three light filters each are used. Each filter of the first disk allows a certain part of the ultra-violet spectrum to excite a fluorescent screen and the corresponding filter of the second disk transmits one of the three primary colours of the white fluorescence excited.

The most essential part of the arrangement for colour vision and colour photography in the ultra-violet is the objective of the microscope. As is well known, it is not possible to realize achromatic objectives of large aperture for the ultra-violet with the use of the transparent lenses available for that region of the spectrum. Hence up to now only 'monochromat' objectives for monochromatic light had been devised by Rohr and Köhler[5]. The only attempt to use for this purpose the new reflexion optics was made recently by Johnson[6]. For colour microscopy, especially the visual kind, achromatic objectives are required. Therefore an objective of a new type based on reflexion optics (numerical aperture 0·50, $f = 6$ mm.) has been made by S. Gershgorin, P. Radchenko and myself following the suggestion of Gershgorin. The optical scheme is shown in the accompanying drawing. The reflexion objective, in contrast with the monochromat of Rohr and Köhler, allows the use of a broad spectral region; in consequence the arrangement is greatly simplified, more convenient light sources being used instead of the high-voltage spark of Köhler's microscope, and the expensive quartz monochromator being replaced by light-filters.



1, 2, MIRRORS; 3, FLUORITE LENS TO COMPENSATE FOR THE CHROMATIC ABERRATION OF COVER GLASS.

The method of staining of objects by organic dyes that are adsorbed on the tissues of the section, applied by biologists, is not highly selective enough and is usually characteristic only of a relatively large group of related substances. More refined investigations are made possible by the use of specific microchemical reactions that result in the formation of dye substances in the object itself. Unfortunately, most of the substances formed as the result of such reactions do not show any marked colour. Hence the search for microchemical colour reactions, especially for complex albumin compounds, is a difficult task. If, however, ultra-violet 'colours' typical for a great number of substances could be found, it is easy to visualize a new field of 'ultra-violet microchemistry', making use of the selective ultra-violet absorption of the products of the microchemical reactions. The development of this field which will follow the development and simplification of the microscope for visual observations in the ultra-violet will constitute an essential addition to the method of colour investigation of microscopic objects by means of the characteristic absorption of natural substances.

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Reverberation in Small Glass Tubes

A CASE of what at first seemed anomalous resonance has been found here in the course of blowing small bulbs on the end of capillary tubes of "Pyrex" brand glass. If a piece of capillary tubing of this glass of between 0·7 mm. and 4 mm. bore and about 8 cm. long is melted at one end and a bulb of about 1 cm. is blown, during blowing and afterwards the tube will be heard to emit a note the frequency of which depends principally on the diameter of the bulb but also on the stem length and the bulb temperature.

If the bulb is thick-walled, the note may continue for a minute or longer; or if the bulb is held in the flame at about 700° C. the note may be sustained indefinitely, or at least until the bulb collapses. While the note continues, an appreciable efflux of air seems to take place from the tube.

Evidently the oscillation starts in a way reminiscent of the troublesome oscillations which make Clement and Desormes' classical experiment on specific heat ratios so difficult, and is sustained by reason of the fact that cold air sucked in during a half cycle is heated up and driven out at increased volume. Crudely, it may be supposed that the condition for sustained oscillation is that $\Delta T/T$ should be greater than $3r^2h/4R^3$, where ΔT is the temperature increase of the air, r and R are the radii of tube and bulb respectively and h is the length of stem. It is probable that the frequency is proportional to the rate of heat transfer from the hot bulb per unit volume of air, and hence inversely proportional to the radius. A bulb of 20 mm. diameter gives a low note near the limit of audibility, so that the production of audible frequencies is limited to tubes of small dimensions.

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Relation between Dissonance and Context

According to Helmholtz's well-known theory[1], the consonance or dissonance of a chord depends on the extent to which its component fundamental tones and their overtones produce beats. Even a cursory study of the methods of musicians, however, and the experience of listening to music, make it seem possible that in actual practice the degree of harshness of dissonances varies considerably according to the way in which they are used and on their context of surrounding chords. A short experiment was planned to test this possibility.

A set of twelve dissonances was devised, of varying harshness and complexity, and each was provided with six different contexts or settings. Each setting consisted of two chords, one before and one after the test chord. In settings *A* and *B* a variety of chords were employed which had been chosen in the hope that they might produce some effect on the degree of dissonance of the test chord; in settings *C* and *F* the test chord itself was simply transposed one tone in sequence, passing the test chord downwards in set *C*, and, with otherwise identical notes, upwards in set *F*; in settings *D* and *E* arbitrarily chosen chords were employed, passing from complex combinations through the test chord to simple combinations in set *D*, and using the identical sets of chords taken in reverse order in set *E*.

The subjects of the experiment were forty-eight students who had some experience in psychological laboratory work; there were forty women and eight men. They were asked to listen to the groups of chords, which were played on the piano in the order *A* 1 to 12, *B* 1 to 12, and so on, and to assess the dissonance of the middle or test chord of each group on a scale ranging from − 3 (very dissonant) up to + 3 (very consonant). They did not find any difficulty in the task. It seems odd that positive assessments were used, though less freely than negative, but this is understandable to us, because, though all technically dissonances, some of the test chords formed very sonorous clangs of sound, and this may be one way in which Helmholtz's theory tends to break down. Two trial sets of chords were used to explain and demonstrate the aim and technique of the experiment to the subjects, and it was made clear that the experiment was not concerned with liking and disliking but only with consonance and dissonance.

The assessments for each chord in each of its settings were converted into scores by multiplying the totals by the corresponding ranks. Correlations were then worked out by the product-moment formula between the scores for each chord in settings *A* and *B*, *C* and *F*, and *D* and *E*. This gave thirty-six correlations, of which, according to the technique explained by Fisher[2], eight differed significantly from zero. These correlations are shown in the accompanying table. If there were no factor at work tending to make the chords sound equally dissonant (or consonant) whatever their context, we should expect no positive correlations. If there was a strong factor tending to make them sound quite different according to the context although they were the same chords, we should expect a large proportion of negative correlations. The fact that we find a small proportion of positive correlations enables us to draw the inference that there is some tendency for the chords to maintain their dissonance- (or consonance-) levels in spite of their changing contexts, but that those contexts have a very marked effect on the chords, tending to alter their level of harshness. The same conclusion is reached from the small magnitude of the correlations, only two of which were above 0·6.

Chord number	Pairs of settings correlated and probability of correlations					
	AB	*p*	*CF*	*p*	*DE*	*p*
2	0·50	<0·01	0·56	<0·01	—	
6	0·48	0·01	—		0·46	0·02–0·01
9	0·45	0·02	0·50	<0·01	—	
10	0·61	<0·01	—		—	
11	—		0·65	<0·01	—	

From these data it must be inferred that the dissonance of a chord depends even more upon the relation in which it stands to its surrounding chords than on the nature of the chord itself. The objection might be raised that the subjects were simply judging the dissonance (or consonance) of given chords in comparison with more (or less) dissonant chords on either side of them. This objection, however, is met by the results for settings *C* and *F*, which consisted of the test chord itself, transposed one tone up or down. In these settings there should, on the usual theory, be no contrasts of dissonance at all. It is perhaps surprising that settings *D* and *E*, which were arbitrarily chosen, should have produced fewer correlations than either *A* and *B* or *C* and *F*. It is clear that the experiment should be repeated with more adequate material composed by an experienced musician.

We are indebted to Mr. Joseph F. Simpson for calculating the correlation coefficients.

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A Y-linked Inheritance of Asynapsis in *Rumex Acetosa*

Genically inherited asynapsis is sometimes met with in a number of plant species, according to observations made by various workers during the last ten years. The most remarkable cases were recently reviewed by Prakken[1]. In a number of the cases observed it was, however, not possible to say with any certainty if the lack of chiasmata at meiosis really was genically determined or not. One of these uncertain cases was observed by Yamamoto[2] in a Japanese male plant of *Rumex Acetosa*, but in *Rumex angiocarpus* I observed[3] asynapsis, which most possibly is of the modificatory type.

In the spring of 1939 I obtained a morphologically normal male plant of *Rumex Acetosa* ssp. *pratensis* from a locality in south-east Sweden. This plant was found to be characterized by a high degree of asynapsis. Although the pollen was almost completely sterile, a progeny was raised by crossing this individual with normal female plants from other localities. The high degree of asynapsis was also met with in all the male individuals of these progenies. The males were highly sterile, but the females were completely normal with a good seed setting.

As the first generation clearly showed that the asynapsis was genically caused, closer analyses of the inheritance of this disturbance were made. These analyses showed that the character is only met with in the male plants. This might, theoretically, be due to *Y*-linked inheritance or—as the number of male plants in the F_1 generation was as low as only six individuals—an *X*-linked recessive character. Closer analyses of the female hybrid individuals showed, however, that they were completely free from the gene for asynapsis. The cross hybrid female × normal male gave only normal males and females, the cross hybrid female × asynaptic male gave asynaptic males and completely fertile females, and these latter females crossed with a normal male also gave only completely normal males and females. On the basis of these results I regard it as most plausible to consider it as definitely demonstrated that the asynaptic gene in this material of *R. Acetosa* is located in one of the two *Y*-chromosomes.

According to Ono[4], Yamamoto[5] and others, the *Y*-chromosomes of *R. Acetosa* are completely inert as to sex-determining genes. The *Y*-linked inheritance of asynapsis in the present material shows, however, that the *Y*-chromosomes are not completely without genes.

A *Y*-linked inheritance of genes other than sex-genes has been previously observed in some few animals, but in plants only a gene suppressing the manifestation of an autosomal gene for 'variegated leaves' in Melandrium may, according to Winge[6], possibly be regarded as completely *Y*-linked.

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Adult Education in Science

IN view of the attention now being given to the replanning of educational systems, experiences gained in Salisbury may be of value in directing adult education of the future along needed lines.

Initially, in 1940, an attempt was made by a number of university teachers to enable junior technical assistants of a Government establishment to complete gaps in their basic scientific training and so be able to continue their studies with greater facility at the end of the War. As time passed, however, it was found that enthusiasm was such that courses on advanced topics could be given successfully. These at once attracted a number of senior workers, who expressed the view that the more advanced discussions, particularly of rapidly developing subjects such as biochemistry, or molecular theories, were of great value to specialists, who feared that their outlooks might be becoming unduly stereotyped since, in many cases, their basic training had been imparted years ago.

I feel that this venture at adult scientific education in war-time is not only a success, but also that it is probably indicative of a widespread latent demand for more detailed information about recent scientific achievements.

It suggests that my pre-war "popular lectures" delivered, in conjunction with social service organizations, on "Science from the Easy Chair" lines were fundamentally misdirected efforts, and that the true function of adult education should be to keep alive, and develop, the enthusiasm for knowledge of those who realize the cultural dangers of specialized occupations, rather than to attempt to arouse faint interests when initiative is lacking.

Few, if any, other countries have so large a proportion of skilled technicians who, in the course of their daily work, have to become extreme specialists with but little opportunity to learn, once their basic training has been completed, even the broad lines of development of scientific thought, or to hear of modern discoveries of interest. Yet to many such specialists (witness those in the light electrical or textile industries) there may well come a time when fundamental scientific advances bring about the derangement of the whole of their prospects of beneficial employment.

If the adult education movement can enable technicians in industry to keep abreast of modern trends of scientific thought, it will be playing a more vital part in the life of the community than if, as at present, it is thought of as an 'escape' from a mechanized age. Unfortunately we are, in Great Britain, tending to mechanize science to the community by not disseminating widely enough the most modern scientific conceptions as they progressively develop in the light of new research.

A few public lectures in big cities, stimulating though they may be, are not enough. There are needed also planned courses at which are discussed current ideas which stimulate scientific thought and new discoveries of significance.

W. A. WATERS.

Salisbury. Aug. 8.

Archæology as a Science

IF all archæologists were of the calibre of Prof. Gordon Childe I could heartily endorse his opinions regarding the scientific status of archæology. But, alas, this is not the case, though no one, I hope, has a stronger belief in the value and importance of archæology, both from the historical and philosophic points of view, than I possess. Prof. Childe quotes as one of the methods of archæology "dispassionate observation". This desirable quality, which I understand is somewhat uncommon in any science, is not, I should have thought, exactly an outstanding characteristic in archæological circles. That, indeed, is my conclusion after many and sometimes exacting years of experience.

J. REID MOIR.

The Mill House,
Flatford, Suffolk.

RESEARCH ITEMS

Archæological Survey of Pickwick Basin, U.S.A.

WHEN the dam at Pickwick Landing on the Tennessee River near Savannah was projected it became obvious that unless an archæological survey of the district was undertaken before the neighbourhood was 'drowned' much important information would be lost (Smithsonian Institution, Bureau of American Ethnology, Bull. 129. "An Archæological Survey of Pickwick Basin in the Adjacent Portions of the States of Alabama, Mississippi and Tennessee." By W. S. Webb, D. L. Dejarnette and others). Some nineteen sites were studied. Several of these showed the copper-galena complex of traits which connect them with other excavations in the Wheeler Basin. It would not appear that anything startlingly new has turned up, but an interesting series of flint implements, pottery and burials has come to light. These regional surveys will, of course, supply the material for a comprehensive account of prehistoric times in the U.S.A. when eventually the time is ripe for such a work to be projected.

Human Bartonellosis

IN a recent paper (*Bol. Of. San. Panamericana*, 22, 304; 1943) Dr. B. Mera of Colombia states that human Bartonellosis is an infectious disease of the most peculiar and constant epidemiology, manifested by fever and anæmia, by a typical skin eruption or by a combination of all these manifestations. The causal agent is *Bartonella bacilliformis*, a Gram-negative organism which is pathogenic for man and *Macacus rhesus*. Three foci of Bartonellosis exist at present in America, namely, in Peru, Ecuador and Colombia. In Peru, *Phlebotomus verrucarum* is the chief vector of the disease, while in Colombia several phlebotomi have been found, but the most responsible is still unknown. The only proved reservoir of the infection is the infected man with apparent or inapparent infection. The blood and reticulo-endothelial system are the structures most affected. At the present time the only effective means of control is by personal protection.

Relative Potency of Carcinogenic Hydrocarbons

SINCE the discovery of the carcinogenic action of 1 : 2 : 5 : 6 dibenzanthracene, 3 : 4 benzpyrene and 20 methylcholanthrene, these hydrocarbons have been used in laboratories in all parts of the world. It is often thought that methylcholanthrene is the most active, and dibenzanthracene the least active, of the three compounds. A thorough analysis of the sarcoma-producing action of the substances in mice has now been made by two American workers, Dr. W. R. Bryan and Dr. M. B. Shimkin (*J. Nat. Cancer Inst.*, 3, 503; 1943), using the statistical methods developed by Gaddum, Bliss and Irwin. The results show that although methylcholanthrene is the most rapid and dibenzanthracene the slowest in action of the three hydrocarbons, tumours are eventually produced with smaller doses of dibenzanthracene than of the other compounds. Much larger doses of benzpyrene are required for sarcoma production than in the case of either of the other substances. The experiments show conclusively that carcinogenic action follows the usual dose-response relationship found in other pharmacological actions. The probit of the tumour incidence is proportional to the logarithm of the injected dose over a fairly wide range of dose levels.

Protein Hormones of the Pituitary Gland

A VERY useful survey of our knowledge of the protein hormones of the pituitary gland is given in *Annals of the New York Academy of Sciences*, **43**, pp. 253–426 (Feb. 1943). Criteria of purity of these proteins such as crystalline form, homogeneity from electrophoretic, centrifugal, sedimentation and solubility measurements as well as constancy of biological activity are discussed. It is pointed out that if the biologist and physical chemist can agree as to what fraction of a preparation is "the substance" and what "the impurity", then the evidence from the physical chemist provides the best criterion of purity within the limitations of the experimental methods. Whether the pressor and oxytocic activities of the posterior lobe reside as an integral part of one large molecule, and the separate principles may be produced by cleavage of the mother molecule during extraction and purification; how far the chemistry has progressed of the anterior pituitary follicle stimulating luteinizing and lactation-initiating hormones, the latter, of course, prolactin, being the first pituitary hormone to be obtained in the pure state; the existence of "mammagen", the factor concerned with the growth and development of the mammary gland—these are some of the points on which evidence is reviewed and present theories are discussed.

Osteology of the Louvar

A DESCRIPTION is given of the skeleton of this fish by William K. Gregory and G. Miles Conrad (The Osteology of *Luvarus imperialis*, a Scombroid Fish: A Study in Evolution. *Bull. Amer. Mus. Nat. Hist.*, 81, Art. II, 1943). The specimen was caught off Cayo Corton Island, Florida, and weighed 200 lb. This is a rare pelagic fish, descending to considerable depths; it seeks its food, in all probability small planktonic organisms, by night, the mouth being small and the jaws without teeth. Its larval stages are exceedingly interesting, the fish undergoing several 'hypermetamorphoses' before attaining the adult form. The main plan of the skeleton consists of three longitudinal supports formed by the backbone and the interlocking bases of the dorsal and anal fins. The tail is large and powerful, with a specialized pivot vertebra at its root, permitting a wide sweep. The brain case is specially strengthened just in front of the first vertebra by extremely dense parts which receive the thrusts of the locomotor system. Otherwise the skeleton is delicate and fragile. The study is a detailed one and the figures are very well executed. There is a full discussion and summary of the structural and functional characters and of the phylogeny and classification.

Pedigrees of Polydactylism

IN more recent times the literature provides pedigrees of polydactylism in a few distinct families over a few generations. J. M. Odiorne (*J. Hered.*, 34, 45; 1934) has collected data in families all descended from a settler in New England in 1644. The pedigree involves ten generations and ninety polydactylous individuals who have an extra finger or toe on one at least of their extremities. The character is believed to be dominant with highly variable expression and penetrance. One wonders whether this weak penetrance observed in some human characters is not a result of polyploid interaction, as in the dahlia.

Dental Malocclusion in the Quintuplets

N. Ford and A. D. Mason (*J. Hered.*, 34, 57; 1943) show that heredity is an etiological factor in malocclusion, in which the jaws do not fit perfectly. Moulds of the dentition of the quintuplets have been taken annually and the time of eruption of the teeth noted. There was a difference of 25·8 per cent between pairs of quintuplets and 60 per cent between individuals in a population in regard to the order and time of eruption of the permanent teeth. This together with other evidence indicates that heredity plays some part in the formation of the jaws. A predisposing cause in the production of malocclusion appears to be the relative time of eruption of both temporary and permanent teeth.

Inefficiency of Iron Utilization

SOYA bean varieties differ in their ability to grow normally in low iron concentrations. M. S. Weiss (*Genetics*, 28, 253; 1943) has found that some varieties grow normally in low-iron cultures whereas others show iron chlorosis and finally die. On the basis of F_2, F_3 and backcross progenies between efficient and inefficient varieties, the author shows that one recessive gene *fe* causes inefficiency and iron chlorosis. Physiological effects of *fe* are higher *p*H, low-soluble iron, high total iron and low potassium contents.

Witches' Broom Disease of Cacao

THE cacao crop in Trinidad and Tobago is menaced with a serious witches' broom disease caused by the fungus *Marasmius perniciosus*. R. E. D. Baker and S. H. Crowdy (Mem. No. 7 Imperial College of Tropical Agriculture, Trinidad, B.W.I.; January 1943) have studied the symptoms and ecology of this malady, and their results are of interest to the general mycologist as well as to the plant pathologist. The fungus can attack vegetative shoots and flowering cushions of the cacao tree, giving variable symptoms. Sporophores are never produced upon green brooms, and only appear on dry brooms after five or six months. A short drought followed by heavy rain brings ideal conditions for sporophore production, and they may appear over a period of two years. Long periods of drought and continuous rain both have a depressing effect upon the appearance of fruit bodies, though they are generally more numerous in the wet season. The fungus is amenable to pure culture on several media, but no fructifications are then formed, even though the organism is homothallic. Spores are liberated mainly at night, when temperatures fall to between 85° F. and 57° F.; their ability to cause the disease has been demonstrated by successful inoculation with pure cultures. Infection with mycelium appears to be incapable of inducing the malady. This fact greatly facilitates control, since brooms removed from infected trees in May and October need not be collected and burned. They are innocuous if left scattered upon the ground.

A Tuned Null Detector

AN article by F. B. Anderson (*Bell Lab. Rec.*, 21, No. 10; June 1943) describes a new tuned null detector which has been designed to eliminate volume adjustment entirely, compressing a volume range of over 100 db. into a variation of the reading of a simple milliammeter, and reducing tuning to a very simple operation that does not require the use of calibration charts or curves. The basic element of the volume-control circuit is a pentode feedback amplifier with an input-output characteristic in which, for inputs less than 40 db. below one milliwatt, the plate current remains essentially constant at its maximum value, but as the input increases above -40 dbm., the plate current decreases, becoming essentially zero at an input of 0 dbm. This characteristic is secured by connecting a diode rectifier between the plate and grid in such a way that as the input increases above -40 dbm., a certain portion of the plate current, rectified by the diode, will increase the negative bias of the control grid and thus reduce the plate current. The grid-to-plate voltage gain in the region of 0 dbm. input approaches unity, so that several stages may be cascaded for input ranges in excess of 40 db. The detector is designed for operation at 1 kc. or at any frequency between 3 and 150 kc., and to permit the single tuning control to act over this entire range, an eleven-point six-gang switch is provided that divides the total frequency range into sub-ranges by switching in different sets of coils and condensers in the output circuit of each stage. The detector may be operated close to the driving oscillator without experiencing cross-talk. The sensitivity is about the same as that obtainable with earphones and a heterodyne operating at its highest sensitivity. The simple tuning and the complete freedom from volume adjustments obtained in this detector make it a measuring instrument that is decidedly superior to the auditory method under many conditions.

Resolution of the Telluric Bands ω_1 and ω_2

A SHORT note by A. Adel (*Astrophys. J.*, 97, 190; 1943) announces the resolution of the carbon dioxide bands at 2·01 μ and 2·05 μ in the solar spectrum. The rotational structure of the bands is clearly revealed, the separate lines being so much as 6 A. apart since alternate lines are forbidden by the selection rules. The rotational distribution corresponds to a mean temperature of $-18°$ C. for the carbon dioxide mass above Flagstaff, Arizona, at noon in January.

Configuration of Glycosides and Sugars

A NEW method for determining the configuration of glycosides and sugars, depending on the alkaline degradation of phenylglycosides, is described by E. M. Montgomery, N. K. Richtmyer and C. S. Hudson (*J. Amer. Chem. Soc.*, 65, 3; 1943). It was found that β-phenyl-*D*-glucoside and β-phenyl-*D*-galactoside are readily degraded by the action of hot aqueous potassium hydroxide to *D*-glucosan $<1,5>\beta<1,6>$, and *D*-galactosan $<1,5>\beta<1,6>$, respectively, while α-phenyl-*D*-glucoside was unaffected and α-phenyl-*D*-galactoside was attacked only very slowly under considerably more drastic conditions. The action of hot alkali on aromatic glucosides has long been known to cause hydrolysis, but most investigators seem to have assumed that the non-phenolic product was either glucose or its decomposition products. It is pointed out that the reactions studied resemble the anhydride formation in *cis*- and *trans*-dicarboxylic acids, and a similar relation to the groups in the glycosides leads to the same configurations as those previously assigned on other grounds.

ROYAL SOCIETY OF CANADA

ANNUAL MEETING

THE annual meeting of the Royal Society of Canada was held at McMaster University, Hamilton, Ontario, during May 25–27. The scientific sections of the Society held their meetings in the Science Building of the University and the general meetings took place in Convocation Hall. The president of the Society, Prof. J. B. Collip, presented the medals at the evening meeting on May 25. The Flavelle Medal was awarded to Prof. B. P. Babkin, research professor of physiology at McGill University, for his outstanding work in analysing the secretory mechanisms of the digestive glands. Prof. John L. Synge, professor of applied mathematics in the University of Toronto, received the first award of the Henry Marshall Tory Medal for outstanding contributions to applied mathematics; and the Willet G. Miller Medal, also awarded for the first time, was presented to Prof. Norman Levi Bowen, distinguished service professor of petrology in the University of Chicago, in recognition of his contributions to geology. Following the presentation of the medals, Dr. Collip read his presidential address on "Science and War". After briefly reviewing the part played by science in former conflicts, Dr. Collip emphasized the important contributions of physicists, chemists and other men of science in the present War. He dealt in some detail with aviation medicine and the co-operation between the men of science and the armed forces in solving many of the problems which modern warfare presents. He referred to the recognition and support that scientific workers are now receiving as an integral part of the war effort, and pointed out that much of this research work is producing results that will be equally important in the post-war period.

A further feature of the meeting was the symposium, held after the dinner on May 26, on "Medical Investigations as Applicable to the Armed Forces", at which Surgeon Captain A. McCallum, medical director-general of the Royal Canadian Navy, spoke in general terms of the organization for research in this service and of the work already accomplished. Surgeon Commander C. H. Best, director of the Royal Canadian Naval Medical Research Unit, gave a more detailed account of some of the results achieved in connexion with nutrition, night-vision and similar problems. Brigadier J. C. Meakins outlined briefly the medical research going on in the Army, and Group Captain J. W. Tice, director of Medical Services (Air), spoke of some problems of interest to the Air Force in particular. This was followed by Squadron Leader K. A. Evelyn, who discussed in further detail many of the special problems in aviation medicine, at the conclusion of which he showed a special moving-picture film entitled "Oxygen". This film was shown as a feature, permission for which had been specially granted. It was prepared under the auspices of the Associate Committee on Medical Research of the National Research Council for use in training enlisted aircrews in the essentials of physiology and the effects of high-altitude flying, pointing out the importance of the special precautions required.

Prof. J. K. Robertson delivered the presidential address in Section III (Chemical, Mathematical and Physical Sciences) on "The Role of Physical Optics in Research", in which he reviewed the discoveries into the nature of light, atomic and molecular structure and in astronomy which have resulted from the application of physical optics in spectroscopy, interferometry and diffraction. This historical account was followed by an address on "Chemical Reactions of Excited Atoms" by Dr. E. W. R. Steacie, and a paper on "Molecular Spectra and their Applications" by Dr. Andrew McKellar, who spoke particularly of applications in astronomy. Thirty-eight papers were presented to the section, the majority of which were read by title. Owing to the pressure of war work, few physicists and chemists were in attendance, but mathematics and astronomy were well represented. Among those papers which were read, mention may be made of a few of some general interest. Prof. Lachland Gilchrist and J. W. Britton gave an account of further experiments on the use of drill holes in electrical methods as an aid to the location of mineralized bodies and rock structure. Dr. J. A. Pearce announced the orbital elements of *H.D.* 222107 λ Andromedæ as revised on the basis of recent measurements and also the orbital elements of the spectrographic binary *H.D.* 34333. A paper of particular interest was given by Dr. L. M. Pidgeon on the production of light metals, in which he reviewed the methods for the separation of magnesium and the difficulties which had to be overcome. He gave an account of his own experiments, which resulted in the present method used in obtaining large quantities of magnesium metal in Canada since the outbreak of hostilities. Dr. H. F. Manske and L. Marion reported the isolation of eight alkaloids from *Lycopodium annotium* L. Several papers were presented by Dr. Paul E. Gagnon and his co-workers, among which mention may be made of one in which the isolation of some new sulphamides was announced. Perhaps the most interesting paper presented to the section was one of those given by Prof. E. F. Burton, in which J. H. L. Watson showed how stereoscopic photographs had been taken with the electron microscope, and exhibited several examples. This new technique enables one to view the objects photographed so as to bring them out in three dimensions, thus adding depth to the pictures and revealing new features in the structure of smoke and metallic particles. At the conclusion of the sectional meetings, Prof. T. Thorvaldson was elected president of the Section for the year 1943–44.

In Section IV (Geological Sciences), Prof. M. B. Baker gave the presidential address and spoke on "Gold and Iron Prospects in Canada". This address was followed by sixteen papers on various geological investigations. Among these, Dr. E. A. Hodgson delivered a very interesting paper on the "Rock Burst Experiments at Lake Shore Mines, Kirkland Lake". He outlined the programme of the investigations carried out since 1939 and gave some of the results already obtained. Equipment has been designed to pick up, amplify and record the small sub-audible snaps which occur in a rock under pressure and which increase in number as the pressure increases. The records of a severe rock burst which occurred on January 29, 1943, show conclusively that the method clearly delimits the area under pressure to within a hundred feet or less. So far, attempts to predict bursts as to time have not been successful; but it is hoped that further work will result in some measure of time prediction.

Prof. G. B. Reed, president of Section V (Biological Sciences), spoke on "Wound Infections and Local Chemotherapy". This paper dealt with the treatment of wounds with the sulpha drugs and emphasized the necessity of applying the drug as soon as possible after the wound had been inflicted in order to obtain the greatest benefit. Fifty-six papers were presented to this Section, many of which will appear in scientific journals. Space permits the mention of the two invited papers only. That by Dr. Babkin, on "Secretory Mechanism of the Digestive Glands", contained a survey of the work of his laboratory on this subject. Briefly, it may be stated that the investigations have established that the mucous, demilune and myoepithelial cell groups of the submaxillary gland each have a separate innervation, and that the surface epithelium cells of the gastric mucosa and the mucoid, peptic and parietal cells of the gastric glands are under independent nervous or humoral control. The conclusions to be derived from this work were stated and further analysis of the secretory function of the digestive glands given. The second paper, by Prof. G. W. Scarth on "The Mechanism of Frost Resistance", contained an account of the modes of frost injury to plant cells and of the protoplasmic changes which accompany frost-hardening. He also discussed how the different hardening changes afford protection. The new president of this Section is Prof. H. S. Jackson.

At the general meeting, Monsignor Olivier Maurault, rector of the University of Montreal and a fellow of Section I, was elected president of the Society, and Prof. J. K. Robertson was elected vice-president.

DAVID A. KEYS.

HERMIT CRABS FROM THE JOHN MURRAY EXPEDITION

DR. E. F. THOMPSON has published some interesting facts in the report referred to below* of collections obtained by the John Murray Expedition. The stations at which the Pagurids were taken are confined to the Gulf of Oman, the south Arabian coast, the Gulf of Aden, the East African coast, the Zanzibar region and the Maldive area, that is to say to the coastal regions and the two Gulfs.

The littoral and shallow-water forms are related to those of the rest of the Indo-Pacific region. The deep-water forms may be divided into those living at mid-depths, which have considerable affinity with those of the North Atlantic, and the only truly abyssal form *Parapagurus pilosimanus,* which occurs at great depths around the edges of every ocean basin in the world. Nothing is known of the life-history of this species. It has always been recorded as housed in a typical zoophyte growth. In the present collection this was not the case; a number of different shells were used, the most frequent being Ianthina. The zoophyte house begins around a shell, and the author has found in two specimens examined from the North Atlantic that this basis was also on Ianthina.

Paguropsis typica, hitherto only known from the Philippines, the Gulf of Martaban and Cape Comorin, was found in the Zanzibar region, thus extending its known distribution another 2,000 miles round the world. Its range in depth is only 32 metres, although its geographical distribution is so wide.

The one new species described is a Sympagurus, *S. burkenroadi.* The suggestion that the three specimens of Glaucothoe, attributed to *G. hendersoni,* found in the collection may be the larvæ of *S. burkenroadi* is most interesting. Whether the large symmetrical deep-water pagurids known as Glaucothoe are adults or larvæ is now practically settled in favour of the latter view, but it is still a matter of controversy as to whether they are abnormal or normal larval forms—the larvæ of small pagurids which have failed to find a shell and consequently have continued to grow in a larval state, or merely natural larvæ of large forms. The latter solution appears most likely to be the correct one, and Dr. Thompson has brought the matter further by finding these Glaucothoes inhabiting shells, with the abdomen twisted, but still with paired abdominal appendages and a symmetrical tail fan. Thus they are further developed towards adult pagurids than any specimen previously recorded. If they are normal larvæ, they must belong to large adults. In the present case the adult is very probably a Sympagurus, and the characters, except for those which are purely larval, agree very closely with those of *S. burkenroadi.* Moreover, one was found inhabiting the same species of shell. We are certainly well on the way to solving the 'Glaucothoe problem'.

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* Paguridæ and Cœnobitidæ. By Dr. E. F. Thompson. (The John Murray Expedition 1933–34, Scientific Reports, 7, No. 5, 1943.) (London: British Museum (Natural History).)

HIGH CRYSTAL HARMONICS FOR OSCILLATOR CONTROL

AN article on this subject by I. E. Fair (*Bell Lab. Rec.*, 21, No. 8; April, 1943) points out that stability is one of the major requirements for oscillators controlling the frequency of radio transmitters. In ultra-high-frequency transmitters it assumes particular importance because a very small percentage change in the frequency of the controlling oscillator may shift the transmitted band many thousands of cycles. At 100 mc., for example, a 0·01 per cent change in frequency means a change of 10 kc., which is as much as the entire width of a broadcast band. Stability in oscillators is secured by some form of tuned circuit. The reactance of such a circuit changes slowly with frequency except over a narrow band in the region of resonance, where a small change in frequency is accompanied by a very large change in reactance, this latter enabling the resonant circuit to act as a frequency stabilizing element. Quartz crystals are eminently suited to control in this way because of their very sharp resonance, which is due to their low values of coupling and dissipation. Their characteristics change only slightly with variations in temperature and voltage, and thus high stability under all conditions is more easily obtained with them than with elements having higher dissipation or greater sensitiveness and voltage.

With the type of crystal most commonly used for oscillators, the frequency of resonance is inversely proportional to the thickness of the crystal. At 10 mc., for example, the thickness of the crystal is only about 6½ thousandths of an inch. Before being used in an oscillator, the crystal must be ground accurately to have parallel faces and to the desired thickness; satisfactory grinding becomes impracticable for crystals appreciably thinner than this. For transmitters requiring higher frequencies it has been almost universal practice to use a crystal with its fundamental resonance below 10 mc. and to employ a harmonic generator to secure the desired high frequency. So far as stability is concerned, this method is satisfactory, but it requires a very appreciable amount of additional apparatus. Not only does the cost of the oscillator go up, but the size also increases, and for many of the high-frequency applications, space is at a premium.

Practically all the circuits used for quartz crystal oscillators require that the reactance of the crystal be positive at the operating point. While harmonics of the fundamental crystal frequency may be used with this type of circuit, therefore, only those giving a positive reactance are possible. Oscillators for a large part of the ultra-high-frequency range have thus been forced to employ harmonic generators, since the 5th harmonic of the thinnest usable crystal is only about 50 mc. This situation has now been changed by a circuit developed in these Laboratories and described in the article, which permits crystal harmonics at least as high as the 23rd to be used for direct control of an oscillator circuit. Oscillators have been built for frequencies as high as 150 mc., using crystals with fundamental frequencies below 10 mc.

SINHALA WEAPONS AND ARMOUR

The *Journal* of the Ceylon Branch of the Royal Asiatic Society for December 1942 contains an article by P. E. P. Deraniyagala on "Sinhala Weapons and Armor". The work of the Sinhalese armourers seems to have elicited great praise from Europeans of the seventeenth century, but one may legitimately doubt whether tempering swords in blood or milk made them any better as weapons, unless it were that they gave greater confidence. The Sinhalese court went in, apparently, for gladiatorial shows; fencing was taught, and foils (or singlesticks) were used in mock combat. The weapons illustrated include the boomerang, both of horn and of wood, and it is worth noting that the Koli name for it is *katariya*: very suggestive of the Latin name for it—*cateia*. The prevalence of the leaf-shaped sword is striking. It is interesting to find in use the feathered javelin, if one can so describe it when the 'feather' was made of metal. Possibly the flat metal vanes were derived from vanes of pandanus leaf such as are used both for crossbow bolts and for javelins in the Assam hills.

A javelin feathered like an arrow appears in the hand of a god or hero in one of Titian's paintings, and Barbosa depicted a similar weapon in the hand of the King of Cochin riding on his elephant; some Eskimo harpoons are so constructed, but the type is a rare one. The author's description of a Sinhalese blowgun is tantalizing. Since he describes it as a wooden tube, it is presumably bored from wood in a single piece. Blowguns of this kind are rarely so long as 80 in. except in Borneo. The tube is tapered, and we are told that "the poisoned dart was fixed with a lump of clay" at the nozzle and propelled by blowing up the tube from the other end, which sounds highly improbable, not to say inefficient. A detailed account of these blowguns, their use and manufacture, of the darts, and of the poison used is much to be desired, as well as some account of the toy blowguns which we are told are still in use. Some of the other descriptions also leave much to be desired. The illustrations are good, but the author is probably wrong in describing Plate I, *b*, as representing wrestlers; the left-hand figure appears to be female and the other to be seated. In general, however, the article contains a useful and well-illustrated account of antiquated Sinhalese weapons. J. H. H.

FORTHCOMING EVENTS

Saturday, September 25

British Psychological Society (at Tavistock House, Tavistock Square, London, W.C.1), at 2.30 p.m.—"Education of the Adolescent".

International Committee for Bird Preservation (British Section and Polish Section) (at the Royal Geographical Society, Kensington Gore, London, S.W.7), at 2.30 p.m.—Dr. Jul. Borucki: "The Future of Bird Preservation in Poland"; Mr. Walter E. Higham: "British Featherland" (colour film).

Tuesday, September 28

British Society for International Bibliography (at the Science Museum, Exhibition Road, South Kensington, London, S.W.7), at 4.30 p.m.—Prof. A. F. C. Pollard: "A Proposed Institute of Information".

Sheffield Metallurgical Association and Sheffield Society of Engineers and Metallurgists (at the Royal Victoria Station Hotel, Sheffield), at 6.0 p.m.—Sir Lawrence Bragg, F.R.S.: "The Strength of Metals".

Wednesday, September 29

Manchester Metallurgical Society, The Institute of Metals and The Iron and Steel Institute (at the Engineer's Club Albert Square, Manchester), at 6.30 p.m.—Dr. W. H. Taylor: "Lattice Structures in Relation to Physical Properties of Metals".

Friday, October 1

Association of Applied Biologists (at the Imperial College of Science and Technology, South Kensington, London, S.W.7), at 11 a.m.—Symposium on "The Control of Insects which Attack Stored Foodstuffs".

Saturday, October 2

Association of Scientific Workers (at Essex Hall, Essex Street, Strand, London, W.C.2), at 2.30 p.m.—Conference on "Problems of Freed Europe—The Challenge to the Medical Sciences". Problems of the Occupied Territories: Belgium (Dr. A. Marteau); Czechoslovakia (Dr. V. Kruta); Greece (Dr. A. P. Cawadias); U.S.S.R. (Prof. S. A. Sarkisov); Present Plans for Relief (Prof. J. R. Marrack).

Geologists' Association (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Mr. G. S. Sweeting: "Wealden Iron Ore and the History of its Industry".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Heads of the Departments of Physiology, Medicine, and Surgery—The Bursar, Royal Veterinary College and Hospital, at The University, Reading (October 1).

Educational Psychologist (full-time) to work in the Child Guidance Clinic—The Director of Education, Education Office, Town Hall, Bradford (October 2).

Educational Psychologist (full-time) to be responsible for the direction of the Child Guidance Clinic, and a Psychiatrist (part-time)—The Director of Education, Education Offices, Woodlands Road, Middlesbrough (October 2).

Chair of Naval Architecture—The Acting Secretary of University Court, The University, Glasgow (October 4).

Headmaster of the Montgomeryshire County Junior Technical School, Newtown—The Director of Education, County Offices, Newtown, Montgomeryshire (October 9).

Agricultural Education Officer—The Executive Officer, War Agricultural Executive Committee, County Offices, Aylesbury, Bucks. (October 11).

Director of Robert Gordon's Technical College—The Secretary, Robert Gordon's Technical College, Aberdeen (October 16).

Professor of Engineering—The Registrar, University College, Singleton Park, Swansea (November 20).

Science Master to teach Chemistry and Physics at a leading Boys' School, Jamaica—The British Council, 3 Hanover Street, London, W.1 (endorsed 'Jamaica').

Lecturer in Natural History—The Principal, Saffron Walden Training College, Saffron Walden.

Lecturer in Nature Study and Biology—The Principal, Dudley Training College, Castle View, Dudley.

Dietitian (woman) in the Food Advice Division of the Ministry of Food—The Secretary, Central (Technical and Scientific) Register, Ministry of Labour and National Service, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. ON.F.1425).

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CONSUMER NEEDS IN ECONOMIC STABILITY

AN admirable report on "The Transition from War to Peace"* prepared by the Delegation on Economic Depressions, of which Sir Frederick Phillips is chairman, has recently been issued by the League of Nations. Although it has received singularly little notice officially, it provides the essential background in the discussions on employment policy which have been stimulated by the Beveridge Report, the Unilever paper, the Nuffield College statement and other publications on that subject; further, it underlines the recommendations already advanced, that we must think out our policies and measures well in advance, and that we should utilize whatever is possible among the international agencies established to further co-operation during the War. No previous official document has set out so clearly the relations between immediate post-war measures, such as international relief, the removal of industrial controls, rationing and the lowering of taxation, and the larger economic policies for the maintenance of full employment and economic stability.

The report opens with the warning that the War is creating economic changes and upheavals which will intensify greatly the forces leading to instability in the post-war world. Policies must be devised in advance in order that the risks of depression and unemployment may be mitigated, and in particular every effort should be made to think out in advance the methods by which as smooth a transition as possible from war- to peace-economy can be effected. If the economic and social objectives of the United Nations are to be fulfilled, means must be devised for maintaining in time of peace the high levels of production and employment achieved in war-time. Independent action by each country for the achievement of full employment and economic stability would inevitably defeat itself. National policies must be co-ordinated, and this pre-supposes the firm establishment of political security and economic policies no longer conditioned by the fear of war.

To the condition of political security must be added that of popular understanding, and this report makes a notable contribution to the comprehension by the rank and file of the people of how much is at stake. Such understanding is an essential complement to the high degree of statesmanship and courage on the part of those responsible for post-war policy which will be required to resist the spurious 'realism', ignoring the effects of national policies on the interests of other countries, which is already discernible in some of the reconstruction reports which have appeared in Great Britain. We cannot, it is true, foresee the conditions that will obtain at the termination of hostilities, but some of the factors, such as the growth of engineering and machine tool industries in various parts of the world, the acceleration of industrialization in certain agricultural areas, shifts in population, etc., are known; it is the broad lines of policy which, as in domestic reconstruction, demand immediate attention.

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* The Transition from War to Peace. Report of the Delegation on Economic Depressions. Part 1. (League of Nations. C.6.N.6. 1943. II. A.) Pp. 118. (London : George Allen and Unwin, Ltd.) 4*s.* 6*d.* net.

Dealing with the objectives of economic policy, the report suggests that first we should think in terms of consumers' needs and then in terms of our mechanical, scientific and human power to satisfy those needs, thus reversing a marked and dangerous tendency of modern publicity policy in industry to which attention was directed by Mr. Alderton Pink in his "Social Reconstruction" and by Mr. Samuel Courtauld in his paper on "Government and Industry". The first objective should be to assure that the fullest possible use is made of the resources of production, human and material, of the skill and enterprise of the individual, and of available scientific discoveries and inventions, so as to attain and maintain in all countries a stable economy and rising standard of living. This was the note struck by Mr. Lyttelton in his speech at Oxford on July 23 when, urging imagination and audacity over the whole field of British industry, he said that it is towards the creation of demand and to the use of inventions that the economic thought of our specialists should be directed.

The second objective should be to ensure that no man or woman able and willing to work should be unable to obtain employment for periods of time longer than is needed to transfer from one occupation to another, or to acquire a new skill. Next, the provision of goods and services to meet the essential physiological needs of all classes of the population in food, clothing, house-room and medical care should be a prime consideration in the use of productive resources. Further, the risk to the individual resulting from interruption or reduction of earning power should be spread over the whole of society; and the liberty of each individual to choose his own occupation should be respected and promoted by equal educational opportunities. Lastly, by courageous international measures of reconstruction and development, the benefits of modern methods of production should be made available to all peoples.

The acceptance of these objectives, which reflect a general orientation of thought that is widely found to-day, should make it easier to avoid or mitigate economic depressions. They involve, moreover, no assumptions regarding the social-economic system or the degree of participation of the State in economic life that may be desired in different countries, other than the responsibility of governments for avoiding large-scale and protracted unemployment.

The second chapter of the report gives an analysis of the domestic issues in the transition from war to peace in countries like Great Britain and the United States, which demonstrates the imperative need for Government preparations in advance and decisions on policy before the War closes. The probable nature of post-war demand is first considered. To get the demobilized men back into employment will be the first concern and may not be too difficult. Production to satisfy consumers' wants, on the other hand, may present enormous difficulties if a runaway price boom and the subsequent collapse are to be averted. The report itself, with its lucid exposition of the reasons why measures taken to control prices and effect an equitable distribution of supplies, both to producer and consumer, should not be abandoned suddenly but relaxed gradually as shortages are overcome, makes an invaluable contribution to the wise publicity required to secure support for such a policy. Government orders and public works are bound to play an important part in facilitating or impeding a smooth transition, and the report repeatedly stresses the necessity for correct timing.

There are two major dangers. First, that projects indispensable for getting the whole national or international economic mechanism functioning again will not be ready, and secondly, that governments will hamper economic recovery by launching too many schemes or launching them at the wrong moment. Governments should endeavour to fill gaps in demand rather than to compete with the market, and the importance of fiscal policies which will encourage enterprise and of government schemes for teaching new skills to meet the new needs that will arise are also stressed. The case for continuance of the controls and for a general government plan over a period of five or ten years could scarcely be better put, and it is all the stronger for the insistence in the report on giving to the consumer all the freedom possible—and freedom from the vice of control for control's sake. No country, however, as the report observes, can hope to keep business active if central control and singleness of purpose are lacking.

No less lucid is the treatment of the international problems of transition in the following chapter. Here again the report insists on the necessity of allowing consumption to expand gradually and smoothly, and that relief and reconstruction should be considered as a single problem. Relief is the first step in reconstruction, and if it fails to reconstruct, it is ineffective charity. It should not only provide for physiological needs, but also enable those requiring help to restore their own economy. Effective programmes of relief and reconstruction will depend on the availability of the essential foodstuffs, raw materials and other goods, and therefore upon the equitable distribution of supplies while supplies are short.

For this reason an international understanding is advocated regarding changes in rations and in the maximum prices to be fixed for goods in the early post-war period. Again, to prevent a scramble for raw products, tonnage, etc., machinery for the purchase and international distribution of such products and for the joint control of tonnage should be continued or instituted, so long as serious shortages persist. As supplies of raw materials become more plentiful, this machinery might be used to stabilize prices by co-ordinating supply and demand and by the creation of buffer stocks. International funds will also be required, for example, in the first instance, to meet the demand for food, raw materials, and certain finished goods, to feed and clothe the populations and gradually to restart production in the stricken areas, as well as for capital to repair the physical damage and make good the wear and tear suffered during the War. The availability of such funds will depend on the relaxation of exchange controls and the possibilities of effecting multilateral clearing and conducting multilateral trade.

In this connexion the report refers to the proposals of the British Treasury and those of the United States to establish some form of international clearing or equalization fund. The control of inflation, the principles on which long-term lending should be based, and the dangers which may be encountered in an effort to realize the general objectives of commercial policy already laid down in the Atlantic Charter and in Article VII of the Mutual Aid agreements, are also discussed and analysed. In conclusion, the report emphasizes the necessity of finding means of co-ordinating the policies of the various international organs required, and, secondly, that economic policy must be correlated with political.

The great value of the report is first in its clear statement of the long-term objectives on which it is based, and it is encouraging to find that those objectives are already accepted in many quarters in Great Britain—for example, in the report on reconstruction issued last year by the Federation of British Industries. In contrast to the timidity of the Federation's report, however, the present report is based on a belief that courage and enterprise on the part of governments and individuals in making prompt adjustments to changing requirements can secure a prosperous equilibrium. That belief also inspires the Planning broadsheet "Employment for All", the Unilever paper on unemployment, and the Nuffield College statement on "Employment Policy and the Organization of Industry after the War".*

The PEP broadsheet in question emphasizes the importance of agreement between the leading nations on economic policy and the special responsibility of the United States and Britain to put their house in order. If they establish full employment and a high demand for imports, they will go a long way towards increasing prosperity in the world as a whole. The transition from war to peace is seen, as in the League of Nations report, as a gradual process, and the broadsheet attempts, first, to outline the guiding principles of a policy for full employment, and secondly, to indicate the operation of those principles in the post-war years.

The immediate cause of cyclical and long-term employment is due, according to the PEP broadsheet, to a decline in demand for capital goods, due in turn to a low demand for consumption goods. Under-investment is largely the result of under-consumption, and the first attack on unemployment is a policy to increase consumption. In this attack the social security system outlined in the Beveridge Report is an important factor, and redistribution of income from higher to lower income groups is also advocated as a means of increasing the spending of the community as a whole.

The second line of attack is investment policy, and here the broadsheet advocates the use of public works as a powerful instrument of business stabilization. The extension of the sphere of public investment is also recommended, and such investment would be determined not by ordinary commercial profit but by social requirements and by social standards such as nutrition, housing and clothing, which could be scientifically ascertained. It is urged that by limiting the sphere of private investment and controlling much of the remainder, the impact on general economic activity of the fluctuations in private investment, which are the main cause of cyclical fluctuations, would be reduced. It is believed that the raising of consumption through progressive redistribution of income and the stabilization of a large part of investment activity would in themselves have a sufficient stabilizing influence on the remaining sphere of private investment.

The proposals of the Nuffield College statement are somewhat different. It recognizes the excellent results to be looked for from a system of social security, and that measures to stimulate investment are indispensable to secure full employment. While, however, it holds that public works, including works undertaken directly at the orders of public bodies and works undertaken by private agencies or contractors as a result of public encouragement, constitute a valuable means of maintaining the level of investment, the cost of such investment should not be met out of higher taxation, as this will react adversely on consuming power. In times of economic difficulty the burden of taxation should be lowered rather than increased.

To enable the State to plan and stimulate investment over a system of priorities according to social needs, it advocates a general extension of long-term economic planning and an extension of the public corporation principle to cover a number of industries and services which are among the largest consumers of capital goods, especially the essential transport services and the main public utilities, both for extensions and replacements. Building, in particular, is a key industry in this connexion, and State policy should be directed towards securing a high and increasing level of output during the period immediately after the War, and thereafter towards ensuring a reasonable degree of stability, in terms of a long-period programme of building, to be accelerated or retarded as part of the deliberate policy of maintaining the level of real investment.

For the execution of this policy, the statement makes one proposal which has already been encountered in the Unilever paper. First, a new method of presenting the national accounts, in which capital expenditure, which would not require to be covered by taxation, is presented to Parliament in a capital budget, embodying plans of economic development framed to ensure a progressive rise in standards of living and amenity. Such a policy of a national stock-taking, which involves the creation of a more efficient and better co-ordinated statistical service than Great Britain has hitherto possessed and the establishment of a permanent Control Statistical Office, adequately staffed for prompt service, is an integral part of this proposal. Secondly, it suggests the establishment of a National Development Board to which should be entrusted the control of funds available for public investment, as well as the functions now performed by the National Debt Commissioners, the work relating to local loans, the functions of the Public Works Loans Board, and the supervision of all State investments in productive enterprise, together with the licensing of capital issues or other forms of capital expenditure which might be made subject to public control. The Development Board, as well as economic planning generally, including the location of industry, would come under a new Minister for National Development.

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* Employment Policy and Organization of Industry after the War: A Statement. Nuffield College. (London: Oxford University Press, 1943.) 2s. net.

The Unilever paper, it will be recalled, considers that a general planning board would be almost helpless in regard to fostering progress and would be apt to discourage rather than stimulate ventures. Again, in contrast to the PEP broadsheet, the Unilever paper holds that under-consumption is in reality a consequence of the interruption of productive activity caused by the trade-cycle and therefore a symptom rather than a cause of depression. Social insurance schemes can make an important contribution to the solution of the problem of poverty, but the real cause of unemployment is irregularity of capital investment, and the essential measures required are government measures which should be planned well in advance and ready for immediate application. Industrial and international measures are indeed also required, and the close similarity between those detailed in the Unilever paper and those in the League of Nations report is encouraging evidence that there is some consensus of opinion as to the measures to be taken.

No one reading the three British contributions on this subject of full employment can doubt that support will be forthcoming in Great Britain for bold planning, or that its industrial leaders will be lacking in initiative and enterprise, or fail to show the flexibility and efficiency required. Even where there are differences of opinion as to primary causes, the action recommended is essentially similar, differing slightly in the relative emphasis on particular points. The importance of correct timing is already appreciated, and in every statement or report we find condemnation of the delay in implementing the proposals of the Barlow Report and in finding a solution of the problems of compensation and betterment studied by the Uthwatt Committee.

On the need for Government decision on policy and for executive action, these reports and papers, like many others, leave no room for doubt. In building and physical reconstruction, in town and country planning, in agriculture, in matters of compensation and betterment, of local government and regionalism, there are confusion and a growing sense of frustration due to the Government's failure to take decisions and announce its policy. Ministerial distinctions between delay and consumption of time increase the scepticism and cynicism which are a disheartening accompaniment of our progress in the War. They are unworthy of the leadership which has brought this nation through the dark days of 1940 and inspired the strenuous exertions, sacrifices and achievements which are bringing us within sight of our goal. No demands made on the Government for the conduct of the War can alter the fact that primarily on them does it depend whether we are to become masters rather than servants of the forces that make for change, and whether we succeed in "the great tasks of rebuilding, of securing the advance of ideas and not letting it be swept back by mere tides of lassitude, exhaustion or reaction—the reconstruction and consolidation of our country in the gains which we shall have made during this hard and long trial". Thus spoke the Prime Minister, and his words must be matched quickly by decision or delegation.

THE ADVANCE OF BIOCHEMISTRY

Advances in Enzymology and Related Subjects

Edited by F. F. Nord and C. H. Werkman.
Vol. 1. Pp. x+433. (New York: Interscience Publishers, Inc.; London: H. K. Lewis and Co. Ltd., 1941.) 5.50 dollars; 33*s*. net.
Vol. 2. Pp. viii+374. (New York: Interscience Publishers, Inc.; London: Imperia Book Co. Ltd., 1942.) 5.50 dollars.
Vol. 3. Pp. viii+408. (New York: Interscience Publishers, Inc., 1943.) 5.50 dollars.

"ADVANCES in Enzymology" is the successor of "Ergebnisse der Enzymforschung", which appeared first in 1932 and ceased to exist after its eighth annual publication in 1939. During this period the "Ergebnisse" achieved a high reputation for the authoritativeness of its articles, which covered most fields of biological chemistry. It was consulted by research workers, teachers and students, who found it a ready means of keeping abreast of a complicated and diffuse literature. Its complete disappearance would have meant a great loss. Fortunately, it has been born again under the title "Advances in Enzymology": edited by Nord and Werkman, and published in the United States. The first three volumes of this annual publication have now appeared and cover the years 1941–43. The high scientific quality of the articles that was associated with the "Ergebnisse" is maintained, and although there has been obvious restriction in choice of authors (due to war conditions), the matter published is instructive, critically written, and embodies many of the most recent developments in biochemistry.

No major advance in the study of enzymes or in our knowledge of the working of the living cell can be imagined taking place without due regard being paid to the composition of proteins, which are known to form the basic structure of enzymes. "Advances in Enzymology" commences appropriately, therefore, with an article (vol. 1) on protein structure by Bull. He deals in an interesting and stimulating manner with the work of Bergmann, Astbury, and Wrinch, regards with extreme conservatism the classification of proteins on a basis of molecular weights, and discusses critically the Bergmann theory that all proteins are made up of whole-number multiples of a definite number of residues. Astbury, whose X-ray analyses of proteins have done so much to advance our knowledge of their structures, has in a later article (vol. 3) considered the propositions of Bergmann and Niemann that (1) the numbers of the different kinds of residues, and also the total number of residues, in the molecule, are always of the form $2^n 3^m$ where n and m

are positive integers or zero; and (2) the residues of any one kind occur at a regular periodic interval along the polypeptide chain. He shows that the best evidence for the validity of the $2^n 3^m$ rule comes from the analytical work of Chibnall on the composition of edestin, though the latter's results with egg albumin do not support the rule so clearly. He concludes from a variety of evidence that the rule operates in the building of the constituent parts of proteins, and sometimes in the building of the whole protein molecules. Astbury reviews the chemical and X-ray evidence bearing on the structure of fibrous proteins (silk fibroin and the keratin-myosin group) and of a number of other proteins, and proposes a model based on the principle that, in general, polar or non-polar side-chains occur alternately along the polypeptide chain.

The fact that plant viruses are nucleoproteins capable of self-multiplication throws into prominence the fact that chromosomes are largely composed of nucleoprotein, and suggests the possibility that the nucleoprotein of chromosomes may also be capable of self-multiplication. Mirsky (vol. 3) ably presents the beginnings that have been made in biochemical investigation of chromosomes and of nucleoproteins generally. He discusses the nucleoproteins of nucleus and cytoplasm, and their relationships to virus proteins. Those of the latter which have been isolated are ribose nucleoproteins—differing thus from the desoxyribose nucleoproteins of the cell nucleus—and are more comparable with the self-duplicating plastids, the chloroplasts, in the cytoplasm of many plants. The great accumulation of desoxyribose nucleoprotein in the chromosome suggests that these proteins are identical with the genes, or are intimately related to the genes. Mirsky refers to the view of Caspersson that the presence of high concentrations of ribose nucleic acid in the cytoplasm during growth is in some way concerned with protein synthesis.

It is obvious that the bearing of nucleoproteins on catalytic processes in the living cell is of the greatest importance for our understanding of cell mechanisms. This is further emphasized in the recent findings concerning the mechanism of enzyme action.

It is now known that many oxidizing systems in the cell require the participation of special proteins and also of defined chemical groupings (sometimes called prosthetic groups, sometimes co-enzymes). The complex of protein and grouping forms an enzyme system. Cozymase—one of the best known of these groupings—is a nicotinamide-adenine-dinucleotide; it can combine with various specific proteins to produce a variety of enzyme systems, each having separate and specific catalytic powers in the oxidation of substances important in cell metabolism. Flavin-adenine-dinucleotide is another such grouping having associations with specific proteins concerned with oxidative processes. Such matters as these are discussed by Green (vol. 1), who deals with the influence of so-called 'trace' substances on enzyme activity. He refers also to the co-enzymic roles of diphosphothiamine, copper, and zinc, and to the possibility that many substances of high physiological activity (insulin, thyroxin, and other hormones) may play a part in the body similar to that of the coenzymes.

The specificity of action of an enzyme system depends not only upon the chemical nature of the co-enzyme but also upon the constitution of its specific protein. There are large groups of enzymes, however (for example, the lipases, sulphatases and proteinases) which are not known to be associated with co-enzymes; their properties must be deemed at present to be determined solely by the configuration of groupings embodied in the proteins themselves.

The general problems of the classification and the specificity of action of proteolytic enzymes are dealt with by Bergmann (vol. 2), and by Bergmann and Fruton (vol. 1), while peptidases receive attention from Johnson and Berger (vol. 2). Bergmann clarifies the somewhat complicated picture which has arisen concerning the specificities of action of the whole class of proteinases and peptidases. He points out that these enzymes may act in two different ways. One type of reaction results by the specific action of a single enzyme on a single peptide bond, while the other type consists of a sequence of coupled reactions involving several peptide bonds and several enzymes. It is the latter type which must be dominant in protein synthesis—if indeed the thesis is correct that protein building in the cell is the result of proteolytic enzyme activity. Johnson and Berger review critically our present meagre knowledge of peptidase systems and point out that "too few current papers take sufficient cognisance of our complete ignorance of the enzymatic constitution of most peptidase systems".

Descriptions of the chemical nature and modes of action of certain enzymes important in oxidative processes in the cell, namely, catalase, diamino oxidase, and verdoperoxidase, are given by Sumner (vol. 1), Zeller (vol. 2), and Agner (vol. 3), respectively.

The oxidative enzyme systems playing a part in tea fermentation form the subject of an interesting article by Houghton-Roberts (vol. 2). He shows that the chemical changes taking place after the rolling of tea leaf—when something like 95 per cent of the tannins present become oxidized—can be explained on the basis that mechanical damage interferes with the normal oxido-reduction equilibrium between the *o*-quinones, produced by tannin oxidation, and carbohydrates in the leaf. As a result of this interference, which leads possibly to dilution of the co-enzymes involved, the *o*-quinones are rapidly condensed to complex tannins.

Enzyme systems in the plant, especially those leading to sucrose formation, are dealt with by Kurssanov (vol. 1), while enzyme systems in tumours form the subject of an article by Greenstein (vol. 3). Greenstein concludes that no simple generalization will cover enzymic behaviour of all groups, or even of any one group, of tumours. The direction and magnitude of the changes taking place when a neoplasm develops depend on the species of animal and the strain in any given species, as well as on the kind of tumour. A clear picture of what takes place can only be obtained by systematic investigation of the many enzyme systems present.

The study of the effects of temperature on enzyme kinetics is reviewed by Sizer (vol. 3). Van Slyke (vol. 2) describes methods in vogue for the study of the kinetics of hydrolytic enzymes such as urease and arginase, and gives a quantitative formulation of the kinetics of the two-phase reaction.

Turning from the study of enzymes to consideration of metabolic systems, excellent articles are to be found on the subjects of photosynthesis (Van Niel, vol. 1; and Frank and Gaffron, vol. 1); of the breakdown of cellulose by micro-organisms (Norman and Fuller, vol. 2); and of the role of micro-organisms in wine-making (Cruess, vol. 3). Van Niel deals only with the phenomena of bacterial photosynthesis. He describes (together with other matters) the metabolism of the green and purple bacteria, and interprets the events taking place on the basis of a photosynthetic carbon dioxide reduction depending on the simultaneous oxidation of special hydrogen donators. The facts and interpretations of photosynthesis in both plants and bacteria are fully considered by Frank and Gaffron, who deal with the thesis that the anaerobic type of photosynthesis is the same in *all* cells, but is supplemented in green plants by the capacity of liberating gaseous oxygen.

Norman and Fuller's article on cellulose decomposition is of particular value just now when knowledge is wanted of the details of the breakdown of straw and plant residues in composts, in soil, and in the animal digestive system. These authors show that important aspects of the breakdown of cellulose can only be investigated by the use of mixed as well as of pure cultures of organisms.

Advances in knowledge of carbohydrate metabolism are reviewed by Barron (vol. 3) and by Krebs (vol. 3). Krebs considers in detail the oxidative changes undergone by substances concerned in carbohydrate breakdown in the living cell. He examines the various schemes and cycles of operations in which these substances may be involved. Barron's article deals mostly with the steps involved in carbohydrate fermentations. It indicates the vital importance of phosphorylations and of the key position taken by pyruvic acid, "the hub towards which comes fermentation, from whence starts oxidation". The importance of the phosphate bond in the changes occurring in the living cell receives due recognition in an interesting article by Lipmann (vol. 1), who describes, in the light of his concept of the energy-rich phosphate bond, many of the metabolic reactions involving phosphorylation and phosphate transfer.

One of the most important advances made recently is the demonstration by Wood and Werkman of the heterotrophic assimilation of carbon dioxide. These authors describe (vol. 2) the phenomenon in detail, and also describe the parts played by carbon dioxide in the metabolism of bacteria and animal tissues.

Advances in biochemistry necessarily involve increased knowledge of the constitution and properties of vitamins and hormones. Biotin receives attention from Hofmann (vol. 3); the elucidation of its structure by du Vigneaud and his colleagues is described, as are its occurrences in free and bound forms, and its role in animal nutrition. Biotin is a most potent growth factor; it is now receiving attention as a possible factor in the development of tumours. Another important growth factor is pantothenic acid, the structure and properties of which are described in vol. 3 by R. J. Williams, who has done so much to elucidate the properties of this vitamin. Deficiency of pantothenic acid in the diet leads to diverse pathological changes, among which are dermatitis and a depigmentation of hair. In fact, pantothenic acid is receiving increasing attention as an anti-grey hair factor. The chemistry and physiology of vitamin K—a 2-methyl-1 : 4-naphthoquinone derivative which is connected in some manner with enzymes involved in blood coagulation, and is sometimes referred to as an antihæmorrhagic factor—are described by Dam (vol. 2). The important adrenal cortical hormones (corticosterone, dehydrocorticosterone, and androsterone) are dealt with by Pfiffner (vol. 2).

Other articles on the structure of glycogen, the respiration of Aspergillus, digestion in the lower vertebrates, and on some properties of bacteriophage, complete a valuable series of reviews, to the continuance of which all biochemists will look forward with interest.

J. H. QUASTEL.

SOIL AND PLANT ANALYSIS

Soil and Plant Analysis

A Laboratory Manual of Methods for the Examination of Soils and the Determination of the Inorganic Constituents of Plants. By Dr. C. S. Piper. (A Monograph from the Waite Agricultural Research Institute.) Pp. xiv+368. (Adelaide: University of Adelaide, 1942.) *15s.*

BOOKS on methods of analysis can be divided into two classes, one of which is the 'collected methods' type. Here each chapter or section of the book is devoted to a specific analysis or group of related analyses, and gives the working details of all or nearly all the existing methods. Such books are not only very useful and convenient but also are a necessity for those analysts to whom the original papers in the literature are not easily accessible. It is, however, the other class of book that the analyst most appreciates, namely, the book in which he is not bewildered by an array of methods but is presented with a selection recommended from considerable experience. Dr. Piper has compiled his book along these lines, and all the methods, with a very few exceptions, are those in use at the Waite Agricultural Research Institute. Concise, and more important still, precise working details are given with ample explanation and a wealth of guidance and help.

In the first section of the book, dealing with soils, the methods, both physical and chemical, are those that are useful in soil survey work and in the study of long-term factors affecting soil fertility. The very simple and rapid methods for estimating fertilizer requirements of soils have not been included, since none has been generally acceptable; and in the opinion of the author such tests are unlikely to simulate the conditions in the soil during the growth of the plant. In the second section of the book, Dr. Piper presents methods for the determination of the inorganic constituents of plants which form a logical alternative to rapid soil methods and are a more reliable approach to the availability of soil minerals, especially those supplying trace elements. Plant analysis is of supreme importance in fertilizer investigations and in studies of animal nutrition problems.

Full treatment is given to the subjects of hydrogen-ion concentration, mechanical analysis, single-value soil constants and exchangeable ions. The methods for the determination of the sesqui-oxides, alkaline earths and alkalis contain just those essential details without which the analyst may find himself in difficulties. The chapter on wet- and dry-ashing is a valuable contribution. To those concerned with plant analysis and to many others the determination of the trace elements will perhaps appeal most of all. Here an organic reagent, dithizone, plays the leading part in the scheme of inorganic analysis. It is used with much success in separating most of the inorganic elements.

There can be no doubt that this book is an outstanding addition to those already written on this subject.

A Family of Devon

Their Homes, Travels and Occupations. By Dr. Vaughan Cornish. Pp. viii+56+10 plates. (St. Leonards-on-Sea: King Bros. and Potts, Ltd., 1942.) 10*s.* 6*d.*

DR. VAUGHAN CORNISH is a geographer who, in addition to his scientific studies of waves on sea and land and kindred geophysical phenomena, has devoted particular attention to the æsthetic aspects of natural scenery. He has long taken an active part in preserving the amenities of rural England and is the donor of South Combe Farm on Sidmouth Cliffs as an open space in perpetuity.

At the beginning of last century, George Cornish, who had been an officer in the Royal Marines and served in India as an A.D.C. to Sir John Shore, purchased an estate at Salcombe Regis, now included in the Sidmouth Urban District, and there founded the Sidmouth branch of the family. Dr. Vaughan Cornish is one of his descendants, and in this book he traces associations of members of the whole ancestral group with the part of South Devon in which they had their homesteads. The book is, however, more than a genealogical record and presents a picture of the life of lesser country gentry farming their own lands from Tudor times to the present day.

Throughout this period the intellectual interests of one or another of the family have been influences for good in the history of England. So long ago as 1775, some letters from Dr. James Cornish, "On the Torpidity of Swallows and Martins", were published in the *Philosophical Transactions*. He was the first of the family to branch out into authorship, and a number of other members have worthily followed him in literary, artistic and scientific fields. On the natural history and country-life sides, C. J. Cornish, a master at St. Paul's School, was a brilliant writer on these subjects in the *Spectator* and other journals. He was a brother of Dr. Vaughan Cornish, whose wide outlook and acute vision have maintained the cultural tradition of the family which he represents so well.

Practical Emulsions

A Handbook of Emulsions, Emulsifiers and Methods of Formulating and Making Emulsions of Practical Value in Industry. By H. Bennett. Pp. x+462. (Brooklyn, N.Y.: The Chemical Publishing Co., Inc., 1943.) 5 dollars.

THE principal object of this book is to deal, in reasonably small compass, with emulsions for the practical worker. Concentrating upon the art of making and applying emulsions, it touches only lightly upon the theoretical aspects, and illustrates these main themes by reference to practical usage.

Rather more than half the book is devoted to emulsion formulæ and directions for formulation. The remainder, under the term "General", outlines such topics as emulsifying agents, types of emulsions and assessment of stability, general methods of preparation and types of equipment employed, together with the related topics of foams, dispersing and wetting agents, and demulsifying and defoaming agents. While much useful practical information is to be found in this part, it does give the very definite impression that emulsion practice is still carried on as an empirical art with very little guidance from an understanding of the basic factors involved. Since the theoretical aspects are touched upon, albeit only lightly, a brief but lucid exposition of modern advances would have been beneficial in enabling the practical worker to appreciate some of these more fundamental factors. In this connexion one is surprised to see the orientated wedge theory of emulsification given so much prominence. It is felt that this part could with advantage have been considerably reduced, leaving all theory to specialized treatises on the subject.

The second part, under the heading of "Formulas", gives an excellent idea of the multitudinous applications for emulsions: agricultural sprays, cutting oils, cosmetics, foods, lacquers, lubricants, paints, paper, waterproofing and so on. No less varied are the ingredients used. The emulsion technologist should find these recipes very useful.

The book is well printed and typographical mistakes are few.

A. E. ALEXANDER.

War-Time Food for Mother and Child

By Dr. Geoffrey Bourne. Pp. 78. (London, New York and Toronto: Oxford University Press, 1942.) 2*s.* 6*d.* net.

THE Minister of Food has shown his appreciation of the special needs of pregnant and nursing women and of growing children by the special allowances that he has made for these groups. However, these requirements are not so well realized by the general public. Anything that hammers in the fact that pregnant and nursing women and young children are the most vulnerable of our citizens is welcome. Dr. Bourne's book gives a clear explanation of the requirements of pregnancy; this is enlivened by information about the development of the fœtus not commonly found in books on nutrition. He might, perhaps, have brought out more clearly the fact, obvious but often overlooked, that the nursing woman has to supply all the constituents of her milk either from her food or from her own body. The extra needs during lactation are therefore more unquestionable than during pregnancy.

Dr. Bourne gives detailed advice about diets, suited to present conditions, from early pregnancy to school years. In some respects this is less satisfactory than the account of requirements and may be unrealistic. For example, as breakfast for a pregnant woman: "In place of orange or lemon juice eat black and red currants or drink infusions of hip and haws when they are available . . . . The water left, when boiling vegetables . . . can be flavoured with Marmite or meat extract and then make a pleasant drink. . . . After the vitamin C supplement a herring or kipper, if obtainable, may be eaten instead of an egg. . . ." How many people could get currants, during their short season, in the past two years? Why not tomatoes, which have a longer season and have been distributed widely if erratically? What proportion of breakfasts can supply egg or fish? The vegetable water would be kept from the previous day; how much ascorbic acid would it contain unless kept in a refrigerator? Such advice tends to undo the good done by the valuable exposition of special requirements. In the more general discussion of diet, Dr. Bourne does not bring out the special importance of green vegetables—the food of which we can get more than we could in peace-time.

With these criticisms the book can be recommended for the material that is not found in other books on nutrition.

SCIENCE IN WESTERN SZECHUAN

II. BIOLOGICAL AND SOCIAL SCIENCES

By Dr. JOSEPH NEEDHAM, F.R.S.

British Scientific Mission in China

IN the preceding article* something has been said of the state of physics and chemistry in the five universities at the great city of west Szechuan, Chengtu. On the whole, the biological work there is even more active. On the West China Union (Huahsi) University campus some excellent taxonomic and ecological work is being done. Thus Dr. Chang Ming-Chun of Huahsi specializes on gastropod systematics and embryology, while Dr. Liu Cheng-Chao of Yenching is a really outstanding authority on Asiatic Amphibia. His collections and data are astonishing, including torrent adaptations, strange breeding habits, etc., and many new species, such as *Vibrissaphora boringii*, a whiskered frog. There are great opportunities for experimental embryology here, which have so far not been taken advantage of. Dr. Liu himself goes on collecting expeditions in the Tibetan borderlands which involve real hardship and danger. For comparative physiology also there are great opportunities, for example, to work with the giant earthworms of the Mount Omei region, species of Pheretima, commonly up to 3 ft. long and at least 1 in. in diameter.

Parasitology has an eminent representative in Dr. Chang Kuei of Chilu, who has done remarkable work on a hookworm survey of the province, with the help of the Rockefeller Foundation. Infestation has a very close association with the maize and sweet potato pattern of cultivation rather than with the rice pattern. If pronounced, it leads to strange phenomena such as geophagia. Among the activities in the fine biological building on the Huahsi campus are also a service for the preparation of biological models in painted plaster for schools and universities, and of injected biological specimens. There is also an interesting project in domestic science under Dr. Peng Yuing-Hua, popularizing jam-making among the Chinese people in order to avoid the hitherto normal annual wastage of fruit. There is a strong school of plant pathology, economic insect pest survey, etc., under the direction of her husband, Dr. Ho Wen-Chun. They both studied in Iowa. Last, but not least, Dr. F. Dickinson's work on animal breeding, fruit-tree improvement, etc., has benefited the whole province and is known throughout China.

Plant pathology leads to reference to a sixth university not mentioned in the preceding article, namely, the provincial University of Szechuan, occupying its own new buildings on an unfinished campus some distance away from Huahsi University. Its strongest side is agricultural science, so that when the Szechuan Provincial Agricultural Experiment Station is also taken into account, the importance of Chengtu as an agricultural centre can be well seen. The plant pathologist at the Experiment Station is Dr. Ling Li, who has described mosaic disease in Cruciferæ, and has published many papers in such journals as *Phytopathology*. He recently collaborated with the Imperial mycologist from New Delhi, Dr. Watts Padwick, who visited China as a technical expert at the invitation of the Chinese Government. The authority on insect pests at Szechuan University is Dr. Tseng Shen, who is very active against tobacco diseases; he leads expeditions through the countryside, giving instruction to the peasants. The Agricultural Experiment Station actually operates an insecticide factory of considerable size, producing pyrethrum powder, copper carbonate and arsenate, etc., with very primitive but serviceable apparatus. In Dr. Liu Chwing-O, the University of Szechuan has an exceptionally eminent authority on wood-boring insects, especially the larvæ of longicorn beetles; she is in touch with the British Museum (Natural History) through the British Scientific Mission. Her work on coleopteran parasites of coleopteran wood-borers is of much interest.

Other departments, too, are worth a visit. At Szechuan Agricultural Experiment Station there is good work going on in crop improvement under the active Dr. Li Hsien-Wen, an associate of the well-known geneticist Dr. Beadle. Dr. Li produces new disease-resistant wheats for the Chengtu plain, but is also interested in cytoplasmic inheritance of variegation in Triticum, and the production of new species of Setaria by crossing. Dr. Li points out that a certain kind of barley, selected at the University of Nanking in 1937, was taken to the United States by Dr. Love, and proved to be so good that 'Wang barley' has by now far more than paid for all the expenses incurred by the United States in sending technical experts to China. Then at the University of Szechuan the botanical department is outstanding. Under Prof. Fang Wen-Pei, very extensive collections of west Chinese and central Asiatic plants have been made; and duplicates are available for exchange with Western collections. Prof. Fang has recently produced a most beautifully illustrated work "Icones Plantarum Omeiensis", which includes descriptions and pictures of new genera as well as many new species. Copies have been sent to Kew and other centres.

In sericulture (Prof. Wang Tao-Yung) the University of Szechuan is strong too; work is under way on comparative silk-gland histology, bacterial diseases of silkworms, survey of mulberry varieties, and physiology of the wild race. Thirty-eight pure lines and many hybrids are maintained in this laboratory. Here again, after the War, there would be great opportunities for a physico-chemical attack on the nature of the spinning process, that is, how the liquid gland contents become the spun fibre. The stranger is surprised to be told that from each cocoon 500 m. of silk fibre can be drawn. Since the old form of the Chinese character for Szechuan contains the radical for insect, Szechuanese sericulturists believe that sericulture originated in their province.

In horticulture also the Szechuanese have an ancient tradition, for this province is thought to have been the original home of the orange. The department at the University of Szechuan points with pride to the treatise of the Yuen dynasty (about A.D. 1200) by Han Yuen-Chih called the "Orange Record". Chinese horticulturists are looking to Britain's Food Investigation Board to give them advice about the erection of refrigeration plants in the province after the War; let us hope that Britain will not be too behindhand in responding to the need for technical experts in China. One worker here comes, indeed, from East Malling, Dr. Chang Wen-Tsai. In the Forestry Department, there is little available knowledge about tung oil trees, for example, not possessed by Dr. Li Ying-Chen. Lastly, in agronomy, Dr. Yang Yin-Kuei is working on colchicine polyploidy, and trying to get the farmers to plant maize as an emergency crop, if the rice fails in July, so that they may have it in September.

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* See NATURE, September 25, p. 343.

In medicine and dentistry, Chengtu is as important as it is in agriculture. The medical school of the Huahsi University hospital under Dr. Leslie Kilborn was famous throughout China long before the War, and though it has lost in access to new equipment since, it has gained by the influx of personnel from the evacuated medical schools. Thus in the Department of Pathology there is the eminent Dr. Hou Bao-Chang of Chilu, now interested mainly in medical geography, and ably assisted by Dr. Chiang Ching-Fen, the daughter of Peter Chiang, the first Chinese to study biochemistry at Cambridge. The difficulties of work in China may be illustrated by the fact that all the records of this group were lost by bombing, started again and lost again by fire; work on leprosy had to be stopped for lack of funds, an experimental monkey colony was started, but had to be abandoned owing to financial straits, and all the time they had to make even their own typewriter ink, which faded on the records, and their own Canada balsam from local resins, which often spoiled the specimens. Perseverance is an inadequate word unless we add some adjective such as heroic.

So also in the Physiology and Pharmacology Departments; Dr. Feng Ta-Rjan of Huahsi investigates Chinese drugs such as the anti-dysmenorrhea *tang-kuei* and the uterine stimulant *i-mu-tsao*, while Dr. Chu Rjen-Bao, an incomer from Nanking (and former collaborator of Dr. A. S. Parkes), works on the sex hormones in relation to the pituitary and spermatogenesis. The Dental College, under Dr. Lindsay and Dr. Agnew, was always pre-eminent throughout China, and with such colleagues as the odontal morphologist Dr. Chou Shao-Wo, bears the greatest part of producing first-class modern Chinese dentists. This work is so necessary for the people of China that it ought to be expanded enormously, and deserves the fullest official financial support.

The Huahsi Medical School is not, however, the only one in Chengtu. There is also the Chungyang Medical School, belonging to the National Central University at Sandy Hook, already described in the third of this series of articles. Here also the standard is very high, particularly in the Departments of Physiology (under Dr. Tsai Chiao, now absent in the United States on a lecture tour), Biochemistry (under Dr. Cheng Li-Bin) and Anatomy (under Dr. Pan Ming-Tse). In Dr. Tsai's absence, Dr. Hsu Feng-Yen (a former collaborator of Prof. Lovatt Evans) presides over no fewer than fifteen research workers, including an able young woman from Amoy, Miss Chu Chiung-Yuing, who is studying acetylcholine physiology. Other work concerns a non-histamine smooth-muscle stimulant found in blood, the intestino-intestinal reflex, the anti-hæmolytic action of cholesterol, and a little-understood local disease known as Chiating paralysis and believed to be due to barium poisoning following the use of insufficiently purified salt. Dr. Hsu and Dr. Cheng pointed out to the visitor with justifiable pride perfusion pumps and kymographs all made in the workshops of the medical school itself. As for the Anatomical Department, Dr. Pan and his colleagues pursue a rather original line of study, namely, the physical anthropology of the soft parts, on which Dr. Pan has himself published many papers. Dr. Pan thus combines the interests of his master, the late Sir G. Elliot Smith.

In this connexion, it should be noted that social anthropology is also not lacking at Chengtu. The distinguished anthropologist Dr. Li An-Che (a pupil of Prof. Sapir) heads the Huahsi Institute of Sino-Tibetan anthropology, which deserves much more support than it has so far, in war-time, been able to receive. Mrs. Li An-Che (Yu Sse-Yü), sister of Yu Dao-Chuan, the Tibetan scholar now in England, also works in the field and speaks Tibetan.

Coming now to Chiating, the biological laboratories of Wuhan University are housed, not in the city, but some distance outside it; they include an old stone thick-walled watch-tower which makes an excellent laboratory. It was Dr. T'ang Pei-Sung (now of Kunming) who deserves a great deal of credit for building up biology at Wuhan. To-day Dr. Gao Shang-Yin, who was trained at Yale, with his collaborators, have there the only laboratory in Free China devoted to non-medical bacteriology; while below the ingenious Dr. Shih Shen-Han teaches plant physiology and pathology, and in the watch-tower above Ling Chun-Yo devises new electrodes for blood *p*H and investigates the permeability of erythrocytes. The watch-tower contains one of the few Warburg manometer sets in China. With its lovely view over the river, the watch-tower symbolically reminds one of John Donne's

> "But up into the watch-tower get . . ."

though the moral is very different. A pool in the river below the laboratories is no ordinary river pool, for there each year a population of freshwater medusæ develops (2,000 miles from the sea). This medusa has been named *Craspedacusta kiatingi* by Dr. Gao and Kung Li-Hua, who have also made studies of its physiology. The whole group of biological departments is headed by Dr. Chang Ting, a botanist of considerable seniority.

Not far from the city is to be found, on a high eminence beneath a tall pagoda, the National Forest Products Research Station. Under the energetic direction of Dr. T'ang Yao, who until the War was in close contact with forestry in most other countries, this is an active centre. While the United States, for example, has only about a thousand species of forest-trees, China has two thousand; in each case about 10 per cent are really valuable. The Station possesses a fine collection of timber specimens from all over the world as well as China, and an admirable reprint and microfilm collection.

Proceeding down the Yangtze, our next biological port of call would be Tongchi University at Appletree Rapids. Here the biological departments are also extremely good. In physiology there is Dr. H. Stübel, who has worked in China for more than twenty years, and with Dr. Liang Tze-Yen was responsible for some historical work on the fine structure of muscle fibres. In botany there is Dr. Wu Yin-Chan, and in zoology Dr. Tung Ti-Chao, who is undoubtedly the most active experimental embryologist in China to-day. He collaborates with his wife, Dr. Yeh Yu-Fung, and they contrive to produce really excellent work in cramped and very uncomfortable surroundings. This has been done, not only by improvising at all stages, but also because Dr. Tung (a pupil of Prof. A. M. Dalcq at Brussels) chose an important problem which could be worked on with the minimum use of stains, wax, microtomes, etc. This problem is that of the determination of ciliary polarity in the embryo, which the Tungs link up with the determination of antero-posterior polarity as a whole in the inducing tissue. They have made a great step forward by demonstrating that the inductor for ciliary polarity is a diffusing chemical substance, and they have already established some of its properties ; it differs from all previously known inductors in being stable to 50° but not to 100° C. It will diffuse into and out of agar. The fact that such a 'field' property as direction of beat can be determined by a diffusible chemical substance throws light on regional differentiation in general, and agrees with the latest views of such an authority as Dr. Holtfreter at the other side of the world. The British Scientific Mission has been honoured to communicate the memoirs of the Tungs to Western scientific journals for publication.

Little has so far been said in this article about the social sciences, but some distance from Appletree Rapids are a number of spacious manor-houses in the hills in which the Historical and Sociological Institutes of Academia Sinica are established. Headed by two famous scholars, Dr. Fu Se-Nien and Dr. Tao Meng-Ho respectively, they have a staff of some seventy scholars all told, thus constituting the largest institutes of the Academy. They guard indeed many precious treasures, such as some of the world-renowned Anyang oracle-bones, bamboo tablets on which the classics were written, and much of the Imperial Archives. There is even a section on physical anthropology, under Dr. Wu Ting-Lang (a former pupil of Karl Pearson and Elliot Smith), engaged in measuring the skulls excavated in association with the oracle-bones. Space is lacking to describe the concentrated atmosphere of learning which prevails in these Institutes, but those who are interested in the history of science, for example, find much willing and kindly help there. Lastly must be mentioned the existence of the National Archæological Museum in this neighbourhood, directed by Dr. Li Chi, and the Institute for the Study of the History of Chinese Architecture, directed by Dr. Liang Se-Cheng (son of the famous scholar, well known in England, Liang Chi-Chao). The section on linguistics in the Historical Institute (Dr. Li Fang-Kuei) is also interesting, with its great collections of gramophone records of dialects of all provinces of China, and song and speech of many peoples.

It will thus be seen that western Szechuan is extremely rich in matters of biological and sociological interest, even in these difficult times.

It is hoped to describe, in a later article in this series, the scientific situation in the north-west.

HISTORICAL DEVELOPMENT OF MICROBIOLOGICAL METHODS IN VITAMIN RESEARCH

By DR. MARY SANDFORD

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THE subject of microbiological nutrition, in its qualitative and quantitative aspects alike, is ever gaining increased prominence. Whereas, until some ten years ago the whole abstruse subject served merely as a minor source of contention among bacteriologists, it has now risen to an eminence sufficient to command the attention of research and other workers in several diverse fields of thought. Thus it would seem not inappropriate to outline the historical events through which these changes have been wrought.

The earliest conceptions of the nutritional fundamentals for bacteria arose as a result of the efforts of bacteriologists to cultivate organisms in chemically defined media. Until this was accomplished the study of the biochemical nature of bacteria, and particularly of diffusible substances elaborated during their metabolism, was very seriously hindered owing to the extremely complex and largely unknown constituents present in the medium. In the case of certain organisms, the provision of recognized substances (whether of organic or inorganic nature) furnishing building and energy materials, sufficed for growth ; in the case of other organisms, especially pathogenic species, cultivation was singularly unsuccessful unless small addenda of natural products were also provided. Thus there originated the belief that the addenda supplied "accessory growth factors" or "bacterial vitamins", which, it was shown, were active at extremely high dilutions and were destroyed by unfavourable conditions of heat, oxidation, etc., in the manner of the animal vitamins.

The existence of the animal vitamins was not postulated definitely before the end of the nineteenth century, although empirical methods of vitamin therapy had been known from much earlier periods. Not until about 1920, however, were vitamins isolated in pure form, their constitution determined and their synthesis accomplished. During the next phase of vitamin research the studies of pioneers like von Bunge, Lunin, Eijkman, Hopkins, Funk and others led to considerable advances, use being made exclusively of higher animals in which distinctive deficiency diseases were usually recognizable. During this same period other investigators concerned themselves with the problem of the existence and nature of "accessory growth factors" functioning in the nutrition of bacteria and yeasts. The third phase of vitamin research was initiated by a change in ideas tantamount to a revolution. It became recognized that substances hitherto found essential for the growth of lower organisms are at the same time no less important in the metabolism of higher animals. Furthermore, considerable emphasis was placed on microbiological studies owing to the great advantages to be gained.

The fusion of the two methods of approach to the study of vitamins had a very pronounced stimulatory effect on work concerning the B complex. It is notable that at least nine B vitamins are capable of detection by microbiological means. It is a reasonable surmise that if chemists had turned their attention to yeasts and bacteria instead of confining it to higher organisms, they would have had the means at their disposal to isolate all the members of the B complex in a much shorter time than was actually required[1]. Nevertheless, even though the course of vitamin research was such as to lack emphasis on microbiological nutrition, microbes have played a leading part in the isolation of six out of nine B vitamins (pantothenic acid, nicotinic acid, biotin, inositol, *p*-aminobenzoic acid and folic acid).

The history of microbial growth factors may be said to have originated in 1860–70 in the controversy between Pasteur, Liebig and Berzelius concerning the possibility of cultivating yeast in chemically defined media. It was noted that growth did not ensue from small inocula[2]. No advance was made, however, until 1901, when Wildiers, working in Ide's laboratory at Louvain, found that large seedings of yeast into certain media were able to proliferate, whereas small ones failed to do so[3]. Wildiers believed the ability to grow to be governed by the presence of water-soluble nutrient material in the large inocula. This material he called 'bios'. It is interesting that this word was coined ten years before Funk introduced 'vitamines'.

Wildiers' claims occasioned much sterile controversy during the subsequent twenty years, the existence of complex nutritional needs being absolutely denied by many workers[4]. The situation was clarified by Copping's decision in 1929 that the 'bios' requirement was governed by the type of yeast and by the composition of the medium[5]. Meanwhile Eastcott, working in Lash Miller's laboratory, accomplished a chemical fractionation of bios and isolated *i*-inositol, which was not otherwise known to be involved in nutrition[6].

Although in 1912 Funk had conjectured a relationship between the then undifferentiated vitamin B and alcoholic fermentation in yeasts, it was not until 1919 that it was suggested that vitamin B might be tested for by measuring yeast growth[7]. However, preliminary work showed that the stimulating substances could be distinguished from vitamin B_1, and the investigation which might have led to the early differentiation of the bios factors was not pursued. Similarly, other assay procedures became abortive when it was ascertained that thiamine was not responsible for the effect[8,9,10,11]; but the work was nevertheless valuable in that it developed the technique of microbiological assays.

Further advances were made possible after 1926 when crystalline vitamin B_1 was isolated from rice-bran[12], thus permitting the investigation of the effect of thiamine alone on yeast growth. Williams and Roehm in 1930[13] stated clearly that Wildiers' bios is a complex mixture of which thiamine is a single component, active in the presence of the other factors. The differences in nutrient requirements of various yeast strains were also recognized, some strains showing no stimulation by any substance readily adsorbed on fullers' earth or precipitated by phosphotungstic acid; such yeasts then cannot be stimulated by vitamin B_1.

Thus in 1930 there was forged the first link connecting the yeast vitamins or bios with the animal vitamins. Since that time many other links have been made. Pantothenic acid was discovered and isolated by its stimulation of yeasts. It was found to be identical with the chick antidermatitis factor[14,15], a factor previously differentiated from riboflavin[16] and from nicotinic acid[17,18]. Pantothenic acid was also found to be identical with a liver factor, isolated by Evans, Happold and Handley, comprising an essential nutrient for certain strains of *C. diphtheriæ gravis*[19], and with a liver filtrate factor required by rats[20,21,22]. It is now recognized as a universal cell constituent, probably common to the metabolic mechanisms of all animals.

Within the years 1939–41 three more connexions were made. Pure pyridoxin, first differentiated clearly as a rat growth-factor B_6 by György[23], was found to stimulate yeasts and therefore constituted a contributing factor to bios[24,25]. Still a further bios factor was concentrated and isolated by Kögl in Utrecht in 1935[26]. This was correlated with the animal vitamins five years later when it was shown to function as vitamin H, the vitamin protecting animals against the specific toxicity due to egg white[27,28]. Yet another link with the animal vitamins was provided when Woolley showed that inositol, known to function in bios, was required as a vitamin by at least one animal, the white mouse. It is remarkable that inositol, unlike most other vitamins, has been known chemically for decades and has only recently been acclaimed as a vitamin[29]. Such was the information which lay hidden in the problem of the nature of bios. Thus yeasts alone might have provided the means of differentiating thiamine, pyridoxin, pantothenic acid, inositol and biotin.

As great a wealth of information was, however, available from studies of other micro-organisms, including fungi and particularly bacteria. The former have not been investigated so thoroughly, but mention may be made of the early and stimulating discovery that vitamin B_1 was essential for the fungus *Phycomyces blakesleanus*[30]. This was the earliest instance of an animal vitamin being indispensable for the growth of a micro-organism, and attempts were soon made to apply the growth-response to measurements of the B_1 content of various products[31].

The volume of work carried out on the vitamin requirements of bacteria, in distinction from other groups of micro-organisms, has been enormous. The conception of essential vitamin-like factors can be traced back between twenty and thirty years. There are many instances in the literature of the need for accessory factors being noted, but little work was performed on the concentration of such factors until about 1935 and onwards. Thus the 'sporogenes vitamin' was first detected by Knight and Fildes[32] and at about the same time a full investigation of the nutritional needs of *Staphylococcus aureus* was made independently by Hughes and Knight[33,34]; in aerobic growth this organism is satisfied with nicotinic acid and vitamin B_1. The biological importance of nicotinic acid had already been shown by Warburg and Christian[35] and Euler, Albers and Schlenk[36], who demonstrated that nicotinamide was a part of the hydrogen-transporting co-enzymes. Later, Lwoff and Lwoff[37] discovered that the Warburg co-enzymes or cozymase functioned as the V factor for *H. parainfluenzæ*. At the same time as Knight was isolating the Staphylococcal factors, J. H. Mueller was concentrating factors essential for the growth of the diphtheria bacillus[38].

Following the recognition of nicotinic acid as a physiologically active substance, animal nutritionists were inspired to test this substance for vitamin activity in higher animals. Nicotinic acid and amide were found potent in curing black tongue in dogs, and nicotinic amide was also isolated from a highly active liver concentrate[39]. Other investigators reported the first successful treatment of human pellagra with nicotinamide[17]. Nicotinic acid, amide and co-enzymes I and II were afterwards found active for organisms of the dysentery group[40], lactic acid organisms[41] and *Proteus vulgaris*[42], and assay procedures based on this activity were proposed.

The components of the bios system were soon recognized to be active not only for higher animals and yeasts but also for bacteria (with the exception of inositol). Thus pantothenic acid was discovered to be required for *C. diphtheriæ gravis*, lactic acid bacteria, *Proteus morganii* and hæmolytic streptococci, and in most cases assay procedures have been proposed[43,44,45,46,47,48].

Vitamin B_6 has been found necessary for *Streptobacterium plantarum* and its use for quantitative purposes suggested[49].

Biotin has already been shown to display widespread biological activity. Besides its well-known functions as vitamin H and in bios, it is contained in the respiratory co-enzyme required by the nitrogen-fixing symbiotic bacteria inhabiting the root nodules of leguminous plants. Biotin is required by the organism *Cl. butylicum* and is known to stimulate members of the acidophilus group of bacteria.

A vitamin not previously mentioned is riboflavin. This is not a member of the bios complex, but is necessary for many higher animals and for certain bacteria. It was isolated from yeast in the form of the 'yellow enzyme' by Warburg and Christian[50]. Riboflavin is well known in the microbiological field for its growth-promotion of *Lactobacillus casei* and related organisms[51,52], this being the basis for many modified assay procedures.

Recently, another compound has been added to the list of the water-soluble B vitamins. This is *p*-amino-benzoic acid. The recognition of the growth-stimulating action of the acid is closely bound up with the theory propounded by Fildes to explain the action of chemotherapeutic agents in preventing the metabolism of pathogenic organisms. Fildes postulated that the chemotherapeutic agent threw out of gear certain enzyme systems in the parasite and that this was accomplished by virtue of the great chemical and structural similarity between the therapeutic agent and one of the co-enzymes[53]. On the basis of this hypothesis it was to be assumed that there existed in animal tissues a substance closely related to sulphanilamide, the function of which was essential to cell metabolism and which, if not capable of being synthesized by the organism itself, would be thereby classified as a vitamin. In 1940 an antagonistic action of *p*-amino-benzoic acid against sulphanilamide was noted *in vitro*[54]. Then it was found that yeast extracts would inhibit sulphanilamide activity and the suggestion was made that this was due to *p*-amino-benzoic acid in the yeast[55]. Furthermore, an *in vivo* inhibition in mice was also observed[56]. The isolation of *p*-amino-benzoic acid from yeast was soon reported[57]. The expected link with animal nutrition was forthcoming the following year when *p*-amino-benzoic acid was shown to be a chromotrichia factor for the rat and a growth-promoting factor for the chick[58]. In general the evidence so far available indicates that *p*-amino-benzoic acid is widely distributed throughout the vegetable and animal kingdoms.

Thus, it is at once apparent that no real distinction exists between the 'animal vitamins' of the B complex and bacterial growth-factors. In not a single instance has a vitamin been shown to have an action for higher animals exclusively, while the great majority, if not all, of the microbiological growth-factors are either essential in the diet of the higher animals or have been shown to be synthesized by the latter.

It is certain that the roll of known vitamins is still incomplete. When, therefore, the task of identification has been terminated, and when rapid and accurate methods of determining each member have been established, it would appear that conditions will then be most favourable for investigating the precise function of the B vitamins. It is not unreasonable to suppose that a thorough comprehension of vitamin function will constitute an advance of immeasurable value in the control of metabolic processes—normal or abnormal—in man and animals.

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OBITUARIES

Prof. Susan Stebbing

DR. L. SUSAN STEBBING, since 1933 professor of philosophy in the University of London (Bedford College), died on September 11 at the age of fifty-seven at Tintagel in Cornwall. Educated at Girton College, Cambridge, she read for both parts of the Historical Tripos and for Part I of the Moral Sciences Tripos. In 1912 she graduated M.A. in philosophy, with mark of distinction, at London. After acting as director of moral science studies at Girton and Newnham, Dr. Stebbing was appointed successively lecturer, reader and professor in philosophy in the University of London.

It was unquestionably to the work of contemporary philosophers at Cambridge that the very marked bent of Prof. Stebbing's philosophical interests and orientation are to be traced. Accepting in the main the 'charter' of the scope and method for all future philosophy set out by Bertrand Russell in his Lowell Lectures, she adopted his recommendation of a piecemeal and co-operative treatment of problems by an 'analytical' method, though in the actual pursuit of this aim and in determining what this analytical method should be, she was less influenced by Russell. Here, as she herself declared, her indebtedness to Prof. G. E. Moore was the profoundest and most continuous through her life, though she also often expressed how much she owed to such other Cambridge philosophers as A. N. Whitehead, C. D. Broad, W. E. Johnson and L. Wittgenstein. Her energies were for the greater part afterwards devoted to the three fields of mathematical logic, the methodology and philosophy of the sciences, and the analysis of problems concerning perceptual knowledge of the external world.

A close and prolonged study of Russell and Whitehead's "Principia Mathematica" and of the works of most other formal logicians present and past eventually entitled her to the rank of an authority in that science. How clear and sure was her grasp of its detail is evident from the article "Logistic" contributed to the "Encyclopædia Britannica" (14th edit.) and in her "Modern Introduction to Logic" (1931)—now in its third edition—in which she skilfully combined the essentials of the newer with those of the traditional logic, and corrected and modernized the theory of scientific method inherited from Mill.

It is in this field that her best work is found, though to readers of NATURE Prof. Stebbing is probably better known as the author of "Philosophy and the Physicists" (1937), where, with much caustic comment, she rigorously examined the attempts of Sir James Jeans and Sir Arthur Eddington to elucidate the philosophical implications of recent developments in mathematical physics. Jeans's argument for the existence of a Great Architect whose activity is that of a pure mathematician and whose thoughts constitute the universe, she rejected as metaphysical extravagance. She complained that these writers, instead of enlightening the common reader, confuse him by approaching their task through "an emotional fog" and by excessive use of personification and metaphor. In the interpretation Eddington placed on his assertion that "the aim of science is to construct a world that shall be symbolic of the world of common experience", she protested at his restricting physical knowledge to the ascertainment of 'pointer-readings' and their connexions, and to his affirming an unknown background correlated with them, the existence of which, she maintained, on his own premises, he ought never to know or even suspect. She likewise objected to his regarding the laws of conservation, gravitation and Maxwell's equations as truisms and not 'controlling laws'; to his assertion that the familiar objects of perception are mere products of "mind-spinning"; to the blurred and indefinite reference in his use of such phrases as "the familiar world", "the external world", "the physical world", "the scientific world", "Nature", "the spiritual world", etc., and the failure to show how one was conceived to be related to another. She condemned, too, Eddington's frequent and large use of the metaphor of 'building' and constructing, and complained that he "nowhere expounded his philosophical ideas in non-popular language", though the communication of exact thought is impossible in inexact language.

Despite the asperity of her stricture, Prof. Stebbing's thinking throughout her writing and teaching generally was strenuous and clear-headed. She spared not herself and strove for consistency, and her judgment, if not highly original, was certainly highly independent. Her students, with whom she was very popular, and her colleagues will deeply deplore their loss. S. V. KEELING.

Sir Francis Fremantle, O.B.E., M.P.

BY the death on August 26 of Sir Francis Fremantle, Great Britain loses the services of a man who devoted the greater part of his life to the promotion of the national health. He was born in 1872, a great-great-grandson of one of Nelson's captains, and fourth son of the Hon. William Fremantle, Dean of Ripon. He chose medicine for his future profession while still a King's Scholar at Eton.

After taking honours in physiology at Oxford, Fremantle did the usual clinical appointments at Guy's, and was one of the very few men to hold both the D.M. and M.Ch. degrees, later also becoming a fellow of both of the Royal Colleges. He served as a civil surgeon in the South African War, and in 1902 acted as assistant secretary to the War Office Commission for the Reorganisation of the Army Medical Service. He then spent several years preparing for the career he had mapped out for himself already in his Balliol days—that of a medical member of Parliament. With this object in view he took the appointment of medical officer of health for Hertfordshire in 1902. He obtained leave of absence to act as plague medical officer in the Punjab in 1903 and special correspondent of the *Lancet* in the Russo-Japanese War in 1904, and to tour the Empire in 1911. He described his varied experiences in "A Doctor in Khaki" (1901) and "Health and Empire" (1911). He served in Gallipoli, Egypt and Mesopotamia in the War of 1914–18 as D.A.D.M.S.

From 1919 until his death Fremantle was Conservative M.P. for St. Albans. He soon became recognized as the leading spokesman of the medical profession in the House of Commons, and was accepted as an authority in all matters relating to the public health. From 1923 he was chairman of the all-parties Parliamentary Medical Committee. He was a member of the Industrial Health Research Board, the Departmental Commission on the Midwives Act, the Central

Housing Advisory Committee of the Ministry of Health and the Inter-Departmental Committee on Nursing.

Fremantle always tried to put before the House of Commons the strictly medical and scientific aspects of the subject under discussion. He was most conscientious, and was very regular in his attendance. Though not brilliant, he was extremely painstaking, and his opinions always received the attention they deserved. During the recent debate on the decline of the population he spoke with great earnestness on the causes and probable effects of the declining birth-rate on the future of the nation. His books brought his views on health problems before a wider public. In addition to those already mentioned, they included works on "The Housing of the Nation", in which he pointed out the shortcomings of housing as they appeared to a medical officer of health in 1927, and on "The Health of the Nation" (1928).

Fremantle was much liked by members of all parties in the House and was equally popular with all classes in his constituency, where he was D.L. and J.P. He lived at Bedwell Park, near Hatfield, and was knighted in 1932. He married Dorothy, daughter of the late Mr. H. J. Chinnery, of Bicester, in 1905 and had one son, Lieut.-Colonel David Fremantle.

ARTHUR HURST.

Prof. T. J. Jehu

PROF. THOMAS JOHN JEHU, who was born at Llanfair-Caireinion, Montgomeryshire, in 1871 and who died at Edinburgh on July 18, will be long remembered for the striking and comprehensive series of investigations he planned and carried out, in conjunction with other members of the staff of the Geological Department of the University of Edinburgh, on the metamorphic and igneous rocks of the Highland Border Series at Aberfoyle and on the Archæan complexes of the Outer Hebrides. His active life falls into three periods: (1) the period of preparation and of post-graduate research; (2) the period of his tenure of the lectureship in geology at St. Andrews; and (3) the period—from 1914 onwards—during which he occupied the regius chair of geology and mineralogy at Edinburgh.

Jehu received his early education at Oswestry High School and thereafter matriculated at the University of Edinburgh, passing through the Faculties of Medicine and Science and graduating M.B., C.M. in 1893 and B.Sc. in 1894. He was early attracted to the study of natural history and, under the inspiring guidance of Prof. James Geikie, laid the foundations of a life-long interest in geological research. He continued his studies at Cambridge, where he had a distinguished career, gaining a first class in both parts of the Natural Sciences Tripos in 1897, and a second class in the Moral Sciences Tripos in 1898, besides winning the Newcombe Prize in Natural Science at St. John's College (1898). During the tenure of a Heriot Fellowship at Edinburgh he completed a valuable bathymetrical and geological study of the lakes and rock-basins of Snowdonia and eastern Carnarvonshire, published in 1902. In 1900 he was elected to the fellowship of the Geological Society of London and in 1902 received the degree of M.D. from the University of Edinburgh.

In 1903 Jehu was appointed to the lectureship in geology at St. Andrews, where the organization of this newly established department and his lecturing and tutorial duties both at St. Andrews and at Dundee demanded most of his energy and time. He found opportunity, however, to prepare and publish two important papers dealing with the glacial deposits of northern Pembrokeshire (1904) and of western Carnarvonshire (1909), in which he discussed in detail the succession of events in the glacial history of these areas and emphasized the evidence provided by the deposits for an extension of the Irish Sea ice. In 1906 he was appointed a member of the Royal Commission on Coast Erosion and took a prominent share in drafting the reports and findings of the Commission issued between 1907 and 1911.

In 1914 Jehu succeeded his old teacher James Geikie as regius professor at Edinburgh, a position which he held until his retirement, on account of increasing ill-health, in June last. To this period belong the outstanding series of contributions to Scottish geology referred to at the beginning of this notice. Following on his discovery of fossils of Cambro-Ordovician age in the Highland Border rocks of the Aberfoyle district, first announced in NATURE of June 6, 1912, he undertook, in conjunction with Dr. R. Campbell, a detailed investigation into the geological succession and structure of this complicated region, the results of which appeared in 1917. This was followed in 1922 by his paper on the Archæan and Torridonian Formations and Later Igneous Rocks of Iona, and in later years by the extended series of researches which he carried out in collaboration with Dr. R. M. Craig on the geology of the Outer Hebrides. The "Geology of the Barra Islands" was the first of this series, appearing in 1923, and was followed by "South Uist and Eriskay" in 1925, "North Uist and Benbecula" in 1926, "South Harris" in 1927, and "North Harris and Lewis" in 1934. This sequence of papers, in which the old gneisses, the later intrusive rocks and the glacial phenomena of the long chain of islands forming the Outer Hebrides were first described in detail, represents a striking contribution to Scottish geology, and its importance was recognized by the award to the authors by the Royal Society of Edinburgh of the Neill Medal and Prize for the period 1925–27. Among the outstanding results of this extended research was the mapping in detail of a belt of highly crushed and mylonitized rock ('flinty crush') along the whole eastern boundary of the islands from Barra to Lewis, a feature which Dr. J. W. Dougal had already noted in 1911.

Jehu's tenure of the Edinburgh chair was also notable for the transference of the Geological Department from restricted and unsuitable premises in the Old College, first to temporary accommodation on the outskirts of the city in 1923, and then in 1931 to the specially designed and well-equipped Grant Institute of Geology.

Most of Prof. Jehu's research work appeared as papers in the *Transactions of the Royal Society of Edinburgh*, but he also contributed to other scientific publications such as the *Geological Magazine*, the *Scottish Geographical Magazine*, the *Transactions of the Antiquarian Society of Scotland*, etc. Before illness laid him aside, he took a prominent part in the various academic and scientific activities of Edinburgh; he represented the University, for example, on a number of public bodies, served as vice-president of the Royal Society of Edinburgh from 1929 until 1932, and was president of the Edinburgh Geological Society during 1917–18.

M. MACGREGOR.

Mr. F. F. Renwick

I JUST missed Renwick at the City of London School. He entered at about the same time as I left and had thus the good fortune to come into contact with Owen Glynne Jones, whose chemical knowledge must have proved a valuable stimulus to Renwick's interest in chemistry. After leaving, he went to the Science Section of the City and Guilds Institute at South Kensington, where he had the privilege of being under Armstrong. He was also in close contact there with Pope, with whom he remained friends for the rest of his life, and he became well acquainted with Philip, an acquaintanceship which helped to further his social development.

Renwick joined the staff of Ilford, Ltd., in 1898, but I had no contact with him until 1910, when I also joined the firm. I remember well those early days when three chemists were for some years the whole of the scientific staff of Ilford, Ltd., those three chemists being Renwick, Store, and myself. I also remember the interminable discussions, not on chemical matters but on politics and above all on religion. One of us was a broad-minded Church of England man, the second a broad-minded Unitarian and the third an Agnostic. Never did those three agree and never did they come to any conclusion, each termination of the argument leaving each of the men with his own point of view intact.

The work in those days consisted of emulsion experiments and constant work on Ilford "pinpoints". This necessitated the use of a high-powered microscope and an everlasting endeavour to recognize the minute particles, chiefly in the gelatine, which were the cause of the particular trouble under review. It was not long, however, before this work gave way to problems which were more intricate and harder of solution. Such problems included the behaviour of translution densities when in optical contact with one another, and I recall the months of argument which went on before the final paper on luminosity by Renwick, Store and Channon was published by the Royal Society.

Renwick's scientific work dealt with at least three recurrent themes. The first of these, photographic sensitometry and tone reproduction, with its fundamental problem of the significance and the measurement of photographic densities, developed stage by stage throughout his working life. Arising from that work he made, with W. B. Ferguson and D. E. Benson, the "F.R.B. Densitometer" which was to serve for many years as a standard. Armed with this instrument, he turned his attention to the broader question of photographic tone reproduction. This led him to consider the desirable sensitometric properties of photographic papers. Secondly, he made contributions to the theory of the photographic latent image. In 1920 he advanced the view that the action of light is to coagulate particles of silver present in the sensitive grains of an emulsion, so as to form a centre large enough to act as a nucleus for development. His third quest was for a photographic material, incorporating fluorescent substances, which would have a greatly enhanced sensitivity to X-rays. Using complexes of lead sulphate and barium sulphate, very efficient and relatively cheap X-ray intensifying media were produced under the names "Kryptoscreen" paper and "Brytex" intensifying leaves.

In 1922 Renwick left for the United States to take charge of the Dupont Film Factory and remained there until 1925, when he came back to England because he felt that the education of his children should take place in their own country. When he returned to Ilford, Ltd., he came as a director.

I have vivid memories of long walks prior to his stay in America. After his return he was too busy to indulge in much walking; had he been able to continue I think his health would have been the better for the exercise.

Naturally, as Renwick's responsibilities increased and the Royal Photographic Society took up more and more of his spare time, not to mention the demands of his growing family, we saw less of one another on the social side. In the latter (war) years of his life he also shouldered the added responsibilities of A.R.P. duties.

Those of us who knew him well feel that we have lost a master of photographic science who can ill be spared from the excellent work he was doing, and know that we shall not be likely to see his equal again.

O. BLOCH.

Mr. R. Borlase Matthews

WITH regret we have to record the passing under tragic circumstances of another pioneer in electrical engineering. Following a bathing accident in which his eighteen-year-old son David was drowned, Mr. Richard Borlase Matthews, who had gone to the boy's rescue, died on August 20 from the effects of shock and exhaustion.

Born in 1876, Mr. Matthews was educated at the Grammar School and Technical College, Swansea, at the Royal School of Mines, and at the Royal College of Science and Central Technical College, London. After serving his apprenticeship with the Milbrook Iron and Steel Company, Swansea, he became assistant engineer with Robert Blackwell and Co., afterwards going to the United States, where he joined the National Electric Co. at Milwaukee, then the General Electric Co. at Schenectady and later the Edison Electric Light and Power Company at Amsterdam. Returning to England, he practised as a consulting engineer in 1906, and specialized in high-voltage electric transmission, the design of power stations, and the applications of electricity to heating and domestic purposes. In 1908 he took up aeronautical work and during the War of 1914–18 he was in the Applied Design (Liaison) Department of the Air Ministry. Afterwards, on his 600-acre all-electric farm at Great Felcourt, East Grinstead, Sussex, he carried out extensive experiments on the application of electricity to agriculture, and published a number of papers on the subject. In collaboration with Dr. Ekstrom, Mr. Matthews initiated a scheme for electricity supply in the areas now served by the Mid-Lincolnshire Electric Supply Co. and in 1930 he was appointed a director of the Company.

Mr. Matthews was a Whitworth exhibitioner, a member of the Institution of Electrical Engineers and an associate member of the Institution of Civil Engineers, as well as a fellow of the Royal Aeronautical Society.

WE regret to announce the following deaths:

Dr. G. E. Pilgrim, F.R.S., formerly superintendent of the Geological Survey of India, on September 15.

Dr. F. J. W. Whipple, formerly superintendent of the Kew Observatory, on September 25, aged sixty-seven.

NEWS and VIEWS

Scientific Director of the Zoological Society of London : Prof. Edward Hindle, F.R.S.

THE appointment of Prof. Edward Hindle, regius professor of zoology in the University of Glasgow, to the post of scientific director of the Zoological Society of London, is in implementation of the policy, decided on more than a year ago, to replace the paid secretary of the Society by an honorary secretary in accordance with the practice of most learned societies. It was then foreseen that it would also be necessary to have another officer who would carry out much of the work performed by the former paid secretary. Dr. Hindle, as the first occupant of the new post now created, will therefore be mainly concerned in organizing all the more scientific branches of the Society's work, such as the scientific meetings, the publications and the library, as well as the prosectorium ; he will also deal with scientific problems concerning the collections of animals at Regent's Park and Whipsnade.

Prof. Hindle, in addition to having a wide knowledge of zoology, has travelled much and has visited most of the Zoological Gardens of the world. Since he went to Glasgow in 1935, he has taken a keen interest in starting a Zoological Park there, and is president of the Zoological Society of Glasgow, in the foundation of which in 1937 he was concerned. He is also on the council of the Zoological Society of Scotland at Edinburgh, a member of the Scottish Nature Reserves Committee, and chairman since 1935 of the executive committee of the Scottish Marine Biological Association. His many other activities include considerable editorial experience, for he is joint editor of the *Quarterly Journal of Microscopical Science* and of *Parasitology*, and sectional editor of the *Tropical Diseases Bulletin*. His research interests have been mainly in the field of protozoology, particularly infections transmitted by insects. Since 1936 he has been Lieut.-Colonel in command of the University of Glasgow O.T.C., and since the War has been in charge of the recruitment and training of potential officers in the west of Scotland. It is hoped that Prof. Hindle will be able to take up his duties in January.

Industrialization in China

THE broadsheet "Poverty and Progress in China" recently issued by Political and Economic Planning (P E P) (No. 209) gives a concise but useful account of the social and economic situation in China, wartime changes and achievements and comments on post-war industrialization. About three-quarters of China's population, or 360 million people, draw their living from about 250 million acres, or only 11 per cent of the total area of China. While much of the remainder is definitely unfit for cultivation, some part of it could be used for agricultural purposes if irrigation were provided and scientific methods of farming used. By modern standards, Chinese agriculture is heavily under-capitalized and over-manned, the Chinese farmer grossly under-fed and overworked. Excessive rents are also a serious matter, but the poverty of communications is one of the greatest causes and consequences of China's material backwardness. Most of the known mineral resources are as yet unexploited, but raw materials required for the consumer goods industries can be supplied at home and some, such as silk, wool, tobacco, leather, furs and bristles, have long formed staple exports. China became almost self-sufficient in raw cotton by 1929.

With regard to the effects of Japanese occupation, at least five of China's six major industrial regions have fallen under Japanese control, as well as the major ports, much of the road and railway network, important mineral resources and the major cotton- and wool-producing areas. The stout resistance put up in face of the invasion, however, gave the Chinese time to evacuate some of their industrial equipment to the interior, and the Government has directly undertaken industrial projects especially in heavy industry and in electricity. It has also gradually assumed control of the allocation and prices of essential materials and of the distribution of labour, but effective administrative control has been hampered by the shortage of experienced personnel, by the size of the country and the poverty of its communications and by inflation. The Chinese industrial co-operatives have played an important part in absorbing moderately skilled workers and craftsmen whose services could not be speedily utilized by the transferred private or Government industry. In regard to post-war industrialization, the broadsheet considers that industrial co-operation may have a great future in China, but will require greater support in the form of cheap credit. Technical and managerial assistance from abroad as well as machines and equipment will also be essential, but population pressure may remain the crucial problem until adjustment is facilitated by improvements in educational standards and enlightenment about family limitation.

U.S. Department of Agriculture

A SUBSTANTIAL part of Dr. Karl T. Compton's Pilgrim Trust Lecture, "Organization of American Scientists for the War", appeared in NATURE of May 29, p. 601. The Information Service of the U.S. Department of Agriculture has pointed out that some of Dr. Compton's remarks about that Department require modification. The Department's initial work was in the field of scientific research, the introduction of valuable plant species, entomology, botany, chemistry, meteorology, and so on. Its first bureau, the Bureau of Animal Industry, was created by an Act of Congress of May 29, 1884, and still carries out research in animal diseases, breeding, feeding, and management of domestic animals, and related subjects. On March 2, 1887, an Act was passed which authorized the establishment, under the direction of the land-grant colleges, of stations in each State to conduct agricultural experimentation. The Office of Experiment Stations was established in the Department of Agriculture, in 1888, to act as a staff agency to administer Federal grants involved in this and subsequent supplementary legislation, and to coordinate researches.

On December 13, 1941, a major re-organization of the Department of Agriculture was announced in connexion with the war effort ; this was validated on February 23, 1943. Seven of the old scientific bureaux and agencies, concerned largely with research work, were combined to form the Agricultural Research Administration. Included also were the four large Regional Research Laboratories, authorized in 1938, and established at Peoria, Ill., Albany, Calif., Philadelphia, Pa., and New Orleans, La. ; the nine Bankhead-Jones Laboratories for research on special agricultural projects; and the Beltsville (Md.) Research Center. At the same time, some of the Bureaux were renamed as follows: Bureau of Animal Industry, Office of Experiment Stations, Bureau of Entomology and Plant Quarantine, Bureau of Human Nutrition and Home Economics, Bureau of Dairy Industry, Bureau of Plant Industry, Soils, and Agricultural Engineering, and the Bureau of Agricultural and Industrial Chemistry. The work of the Regional Research Laboratories is now closely integrated with the last.

In addition to these agencies in the Agricultural Research Administration, the Department of Agriculture carries on considerable scientific research in the Forest Service and in the Soil Conservation Service. The Forest Service works in twelve forest and range experiment stations, and the Forest Products Laboratory at Madison, Wis.; the Soil Conservation Service investigates soil erosion and water depletion, and develops methods of soil and water conservation in co-operation with State agricultural experiment stations. Finally, the Bureau of Agricultural Economics is the central statistical and economic research agency of the Department, and has done outstanding work in social and economic science. As a result of Presidential Reorganization Plans announced in 1939 and 1940, the Weather Bureau was transferred to the Department of Commerce, the Food and Drug Administration to the Federal Security Agency, the Bureau of Public Roads to the Federal Works Agency, and the Bureau of Biological Survey to the Department of the Interior, where it became part of the Fish and Wildlife Service.

Summer School in X-Ray Crystallography

A SUMMER SCHOOL in X-ray crystallography for scientific workers in industry, which was first suggested at the second conference on X-rays of the Institute of Physics, was held in Cambridge during September 6–18. It was organized by the Board of Extra-Mural Studies of the University in co-operation with the Cavendish Laboratory and the Department of Mineralogy and Petrology. Only about one third of the applicants could be accommodated; the whole course was attended by twenty-two, and, in addition, a small number were present for one week. The main object of the course was to familiarize X-ray workers in industry with the techniques used in solving fundamental problems. Thus they should be better fitted for dealing both with the routine work in industrial organizations and with the special problems that arise from time to time. Accordingly the earlier part of the course was devoted to the study of single-crystal X-ray photographs, and possible and actual practical applications were pointed out. The orientation of diamonds in the making of dies for wire drawing and of artificial sapphires for pivot bearings were two such examples. The latter part of the course dealt mainly with powders and polycrystalline aggregates, with special reference to metals. The applications of X-ray methods to the study of equilibrium diagrams, of stress and strain, and of preferred orientation in wires and sheets, were described in detail; these were augmented by a lecture by Sir Lawrence Bragg on "The Strength of Metals". The identification of materials by the X-ray Index of Powder Photographs was also dealt with. Nineteen lectures were given altogether, by Drs. N. F. M. Henry, H. Lipson and W. A. Wooster: each lecture was followed by two hours of practical work in which assistance was given by Miss A. M. B. Parker and Dr. D. P. Riley. Since it was not possible for the students actually to use the X-ray apparatus, the practical work was based on photographs or measurements already in existence. Opportunity to see and handle the apparatus was given in special visits to the research laboratories of the Department of Mineralogy and Petrology and the Cavendish Laboratory. The course was noteworthy as an example of fruitful collaboration between industry and a university. At the present time many industrial firms make great use of X-ray diffraction methods, and at the same time, university teachers, in order to train students effectively, need to keep in touch with the practical requirements of industry.

The Cannibal Complex

PROF. J. H. HUTTON's presidential address to the Folk-lore Society deals with the subject of cannibalism (*Folk-lore*, **54**; 1943). The thesis is upheld that the origins of the practice were many and various, and that several causes were responsible for the growth of the custom among any given people. Among the reasons for the eating of his own kind by man, Prof. Hutton enumerates the following: famine, lack of meat food in the case of folk living largely on such starchy materials as potatoes and manioc, etc., revenge, and magic. In the last case ideas of sacrifice, of obtaining the life essence or qualities of the person eaten, and of getting an extra 'dollop' of soul-stuff by the same means can be traced. One is told that 'long pig' makes good eating, but Prof. Hutton does not include this possible motive. It would appear that no one of these reasons by itself is sufficient to generate the custom—indeed the fact that among some cannibals only criminals are eaten suggests that, on the whole, man does not relish eating man. When, however, several of the above factors operate, for example, when famine has started the practice, then it may develop into a custom as a result of the operation of one or more of the other motives. Such an analysis of a 'savage' practice is very interesting and helps to show the ordinary Englishman how complex are the ideas of modern primitive peoples.

The Cuscatlan Bridge in El Salvador

THIS bridge is the largest in Central America, and has been erected across the Lempa River, to complete another link in the Pan-American Highway (*Earthquake Notes*, **14**, Nos. 3 and 4; June 1943). The main suspension span of 820 ft. is carried by cables of open construction chosen to fit the unusual erection conditions. The bridge is near the base of an extinct volcano, and test borings indicated that the foundations and anchorages would be in volcanic materials consisting of cemented ash and loose boulders or stones. These materials lie in very irregular strata and pockets. Since the bridge may be subjected to earthquake shocks, special care was necessary to support the assumed earthquake forces in the design of the concrete approaches. A study of this feature indicated that multiple-span rigid-frame structures were required. A factor in the design of structures built to resist earthquakes is the natural period of vibration. Resonance must be avoided by making this different from the supposed destructive earthquake frequencies likely to arise in the district. In this case periods of from 0·5 sec. to 1·5 sec. were avoided. The natural periods of the transverse bents of the Lempa River Bridge concrete approaches is less than 0·5 sec. and that of the longitudinal frames is of the order of 0·25 sec. A factor contributing to the safety of the longitudinal frames against resonance is the varying heights of the columns, each of which has a natural period of its own different from the others. Tunnel anchorages have been used. The principal mass of the bridge is contained in the main-span trusses and the floor, and this mass would produce the greatest transverse earthquake force on the towers at the level of the trusses. The cables have a small mass but transmit heavy loads to the towers. The earthquake forces on the towers from the cables would be small, and the conservative design of the bridge was not affected by the assumed earthquake forces.

Distribution of Typhus

ACCORDING to an editorial in the March issue of the *Boletin de la Oficina Sanitaria Panamericana* the Panamerican Committee on Typhus and other Rickettsial Diseases set up by the eleventh Panamerican Congress held in Rio de Janeiro in September 1942 has come to the following conclusions. With improvement in the methods of investigation the number of cases and the extent of the geographical areas are becoming more apparent. In Chile and more recently in Bolivia and Columbia there have been several epidemics of typhus. Sporadic cases or small epidemics have been repeatedly notified in the Argentine, Brazil, Peru, Ecuador and Venezuela, while in Central America serious outbreaks have been reported in Guatemala as well as cases in El Salvador, Honduras and most of the Caribbean Islands such as Cuba, Puerto Rico and Jamaica. These diseases form one of the major health problems in some parts of Mexico and the United States, and cases have also been seen in Canada. The rickettsiases found in America may be classified into the following four groups: (1) epidemic, classic, European or louse-borne; (2) endemic, murine or flea-borne; (3) Rocky Mountain spotted fever; and (4) *Q* fever or nine mile fever, Japanese river fever or tsutsugamushi apparently not found hitherto on the American continent. The problem is particularly serious at the present time owing to the War, the rapid transportation of large numbers of persons to and from infected zones and the difficulty of enforcing maritime and aerial quarantine.

Earthquakes Registered in Spain

DURING May and June 1943, forty-five earthquakes and earth tremors were registered by the five Wiechert seismographs at the Observatory at Toledo, according to provisional bulletins just received. During May there were sixteen shocks, the strongest recording being on May 25, when an earthquake beginning with an unidentified emergent pulse at 23h. 22m. 23s. attained a maximum amplitude of 480 μ on May 26 at 00h. 09m. 17s. An earthquake with an estimated depth of focus of 230 km. began recording with *iPze* at 17h. 29m. 54s. on May 2. During June there were twenty-nine shocks registered. The greatest registration was on June 13, when an earthquake, beginning with *iPz* at 5h. 24m. 56s., attained a maximum amplitude of 270 μ at 6h. 05m. This shock had a depth of focus of 100 km. The shock of June 20, which was reported as destructive at Adapazar in Turkey, first registered at 15h. 38m. 29s. and attained a maximum amplitude at Toledo of 41 μ at 15h. 51m. (NATURE, July 3, p. 17).

Ciencia

AN editorial note in the first issue for 1942 of *Ciencia: Revista hispano-americano de Ciencias puras y aplicadas* (published in Mexico) expresses the hope that its publication, interrupted for a time, will be regular and punctual in the future. Issues for the first half of 1942 deal with a great variety of subjects, some of cultural interest, others of a practical and technical character, and in addition, it contains short items of scientific importance from a great number of countries. Of special interest is a series of articles (not yet completed) by Prof. B. Cabrera, of the National University of Mexico, entitled "El Atomismo y Su Evolucion", which provide an excellent account of the developments in our knowledge of atomic physics from the days of Democritus and Leucippus up to modern times. Dr. Honorato Castro contributes an article on the determination of the distance between two points on the earth's surface with sufficient accuracy to serve the needs of aviators. A spherical earth is assumed in the first case, and then it is shown how corrections can be applied when an ellipsoidal earth is considered. Biological and medical subjects are prominent, and among the latter may be noticed an important article by Dr. S. Obrador Alcalde, with the title, "Mecanismos Neurales De Los Ritmos Electricos De La Corteza Cerebral". The author, who is connected with the Laboratory of Medical and Biological Research, School of Medicine and Institute of Neuro-Psychiatry, Mexico, deals with investigations. These few references will suffice to show the scope of the journal, and it may also be mentioned that a considerable amount of space is devoted to reviews of scientific works.

Announcements

DR. A. H. ROSENTHAL, well known as a physicist and electronic engineer, has been appointed director of research and development of Scophony Corporation of America. Dr. Rosenthal has been connected with Scophony, Ltd., of London, for several years, and in his present position will head a group of scientific men and engineers engaged in research and development of fundamental inventions, not only in television, but also in the ever-widening field of electronics, including various applications of supersonics.

THE inaugural meeting of the X-Ray Analysis Group of the Institute of Physics will be held, by invitation of the Manchester and District Branch of the Institute, in the Physics Department of the University of Manchester on October 16. Sir Lawrence Bragg will open the meeting with a lecture on "The Physical Optics of X-Ray Analysis", which will be followed by four short papers and an exhibition of X-ray apparatus relating to industrial problems.

THE late Sir Horace Boot, the distinguished engineer, has bequeathed £5,000 to the Institution of Civil Engineers and £1,000 each to the Institutions of Mechanical and Electrical Engineers.

REFERENCE was made in NATURE of September 25 (p. 352) to the new American publication, *Mathematical Tables and Aids to Computation.* We are asked to state that the agent in Great Britain for this periodical is the Scientific Computing Service, Ltd., 23 Bedford Square, London, W.C.1 (subscription £1).

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Urinary Elimination Products Following Ingestion of Nicotinamide (F_2 of Najjar and Collaborators)

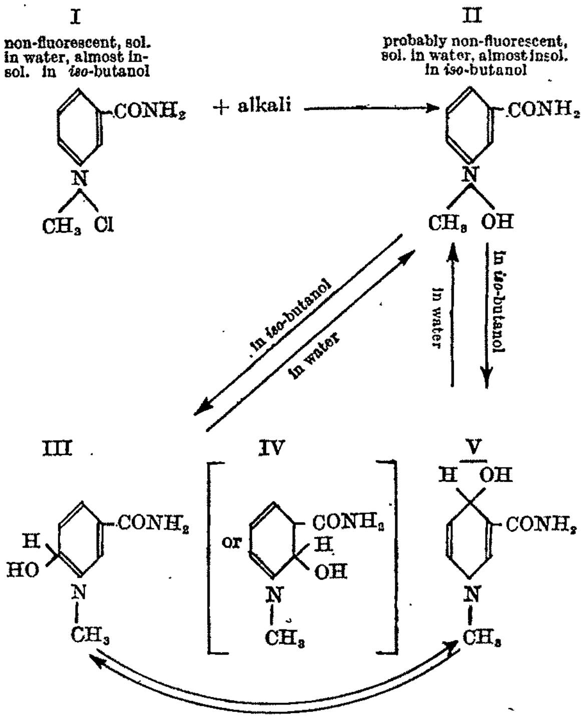
ABOUT three years ago Najjar and collaborators[1] started publishing a series of papers on two pigments eliminated respectively in urine of pellagrins (F_1) and of normal persons (F_2); the F_2 output is increased after the intake of nicotinamide and related compounds. Both pigments could be made visible by the following method. Urine was adsorbed on 'Decalso' (a synthetic zeolite), the adsorbate was eluted with 25 per cent potassium chloride and the neutral potassium chloride eluate was extracted with *iso*-butanol to obtain F_1, while F_2 was extracted after the alkalinization of the potassium chloride eluate. In long-wave ultra-violet light F_1 showed a violet and F_2 a silver-blue fluorescence. Coulson, Ellinger and Platt[2], when examining concentrates of F_2, observed a number of properties of F_2 (absorption spectrum, emission spectrum, behaviour towards hyposulphite, changes of fluorescence with the *p*H and sublimation in high vacuum) which suggested the similarity of F_2 to thiochrome. Recently Najjar, Scott and Holt[3], and Huff and Perlzweig[4], published papers on the probable nature of F_2. The former discussed the similarities and dissimilarities of F_2 to reduction products of N-methyl-nicotinamide prepared according to Karrer *et al.*[5]. The latter showed a number of properties of F_2 which were identical with those of N-methyl-chloro-nicotinamide. These publications prompted us to publish the results of the present state of our investigation.

Large amounts of urine collected after the intake of large doses (200–750 mgm.) of nicotinamide were filtered through 'Decalso' columns; the columns were eluted with potassium chloride, the alkalized potassium chloride eluates extracted with *iso*-butanol, and the dried *iso*-butanol extracts concentrated in the early experiments *in vacuo* at about 60°. Non-fluorescent solids were removed from the concentrates and the extract was taken down to a thick yellow oil which would not crystallize. Fractional sublimation in high vacuum showed the presence of at least five fluorescent constituents all of which were coloured. Filtration of the *iso*-butanol solution of the concentrate through an Al_2O_3 column revealed the presence of at least five fluorescent substances which could be separated by differential elution. The large number of various pigments suggested possible deterioration by heat, so the concentration of the *iso*-butanol extracts was carried out at room temperature. The adsorption of *iso*-butanol extracts prepared in this way on Al_2O_3 revealed the presence of not more than two fluorescent substances. One, F_{2a}, is light amber with purplish-blue fluorescence, weakly adsorbed on Al_2O_3 and quickly eluted by *iso*-butanol or chloroform. The other substance, F_{2b}, is strongly adsorbed on the top of the column; it is green-yellow with silver-blue fluorescence and quickly eluted by methanol. Neither of these fluorescent pigments is present in the original urine or in the neutral potassium chloride eluate, which is non-fluorescent. The fluorescent pigments are formed in the potassium chloride solution from a non-fluorescent precursor on alkalinization. The fluorescence of the alkaline aqueous phase is very slight. The substance causing the fluorescence is extractable with *iso*-butanol and the fluorescence intensity in *iso*-butanol is at least four hundred times as great as in the alkaline aqueous solution. In a number of fluorescent pigments which are soluble both in water and *iso*-butanol the fluorescence intensity in *iso*-butanol is about 1½ to 3 times higher than in the aqueous solution (*cf.* Ellinger and Holden[6]).

The great difference of the fluorescence intensity in water and *iso*-butanol and the extractability of the fluorescent substances from the aqueous phase by *iso*-butanol suggests the presence in water of two forms of the pigment, a non-fluorescent and a fluorescent one; the equilibrium in water is greatly in favour of the non-fluorescent modification, which contrary to the fluorescent one is almost insoluble in *iso*-butanol. Extraction with *iso*-butanol gradually transforms the non-fluorescent modification into the fluorescent one, which is accumulated in the *iso*-butanol.

Differences in *p*H, dependence of adsorption and the finding that the genuine potassium chloride eluate was non-fluorescent and became so by alkalinization excluded the possibility of the identity of F_2 with thiochrome, which cannot be formed from non-fluorescent precursors by alkalinization of a neutral solution.

The analogy with the elimination of trigonelline after nicotinic acid intake suggested the possible formation in the body of N-methyl-nicotinamide by methylation and its connexion with F_2. Two points were against this assumption: N-methyl-chloro-nicotinamide, first prepared by Karrer *et al.*[5], is non-fluorescent and, having a pyridine configuration, can be expected to show an absorption maximum around 260 mμ and not around 360 mμ, as shown for F_2 by Coulson, Ellinger and Platt[2]. Both objections were overcome, the first one by the observation that the



III, IV and V probably fluorescent, soluble in water and *iso*-butanol.

fluorescence of F_2 developed only *in vitro* and the second by the following consideration and its confirmation by the ultra-violet adsorption spectrogram.

The N-methyl-chloro-nicotinamide (I) is non-fluorescent, soluble in water with an absorption peak at 264 mμ and a shoulder at 270 mμ. By alkalinization it forms the probably non-fluorescent quaternary pyridinium base (II) with the same absorption as (I) and an additional small peak at 240 mμ, which in analogy with the findings of Decker and Kaufmann[7] and Hantzsch[8] on alkyl pyridinium bases will change by migration of the OH group into a tertiary carbaminole (III, IV or V). These will be fluorescent. In the aqueous phase the equilibrium favours the quaternary base (*cf.* absorption spectrograms). II is almost insoluble, III, IV, V are soluble in *iso*-butanol. The silver-blue fluorescent F_{2b} might correspond to III or IV, the purplish fluorescent F_{2a} either to V, according to its spectrogram and to Karrer's[5] description of the properties of *p*- and *o*-dihydropyridine derivatives, or less probably be an oxidation product of II or III, since its fluorescence resembles that of the aqueous alkaline solution of I after treatment with potassium ferricyanide.

When N-methyl-chloro-nicotinamide (I), prepared according to Karrer *et al.*[5], was dissolved in water, made alkaline, extracted with *iso*-butanol, adsorbed on Al_2O_3 and eluted with *iso*-butanol and methanol respectively, two compounds were obtained: one of amber colour and purplish fluorescence was eluted with *iso*-butanol or chloroform and another one of green-yellow colour and silver-blue fluorescence was eluted by methanol. They were indistinguishable from the two corresponding urinary compounds obtained in the same manner. The respective ultra-violet absorption spectrograms, the fluorescence concentration curves and the absorption concentration curves for 365 mμ and their reactions to alkali and acid were identical. The purplish fluorescent F_{2a} and the corresponding synthetic compound are comparatively stable to heat and acidification. They have an absorption band in *iso*-butanol with peaks or shoulders at 271, 306 and 347 mμ and an emission band between 438 and 521 mμ and a maximum at 464 mμ. The fluorescence is slightly diminished but not altered in hue by strong acid and not affected by alkali. The yellow silver-blue fluorescent F_{2b} and the corresponding synthetic compound are far less stable, more stable in *iso*-butanol than in methanol, and oxidize by standing in air, particularly when heated. They have an absorption band in *iso*-butanol with a maximum at 358 mμ and a step-out at 268·5 mμ (due to contamination with II ?), an emission band between 446 and 549 mμ with a maximum at 500 mμ; acidification with HCl shifts, in both F_{2b} and the synthetic compound, the position of the absorption maximum to 311 mμ. We have not prepared salts of F_2.

The formation of two different fluorescent compounds from the non-fluorescent precursor may explain the variation in hue of F_2 observed in routine assay, which varies from a deep purplish-blue to a light silver-blue.

F_2 appears in urine after the intake of not only nicotinamide but also of nicotinic acid, mono- and di-ethyl-nicotinamide. Ingestion of nicotinic acid and still more of mono- or di-ethyl-nicotinamide produced less and considerably more delayed and prolonged elimination of F_2 than that of nicotinamide (Coulson, Ellinger, Platt[2]). It is apparent that F_2 is formed from N-methyl-chloro-nicotinamide, and this would indicate the formation of an amide from an acid in the body, a process so far as is known without analogy.

Details of this investigation will be published elsewhere. Experiments to determine the structure of the compound are in progress.

To summarize: F_2 is not eliminated as a fluorescent pigment from the body, but formed *in vitro* from a non-fluorescent precursor by alkalinization. F_2 is composed from two fluorescent compounds which can be separated by adsorption on Al_2O_3. Substances so far indistinguishable from them can be obtained by the action of alkali from N-methyl-chloro-nicotinamide.

The authors wish to thank Messrs. Roche Products, Ltd., for the gift of nicotinamide, Dr. Edna Roe for the preparation of the ultra-violet spectrograms, and Miss M. Holden for the fluorescence measurements.

This work forms part of an investigation on nutritional deficiencies being carried out on behalf of the Air Ministry.

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Digestibility of Oatmeal Phytin by Adult Man

McCance and Widdowson[1] found that adult man excreted approximately half the ingested phytin of wheaten flour unchanged in the fæces and that the phytin seriously interfered with the absorption of dietary calcium. It appeared important to us to investigate the availability of the phytin of another staple cereal, oatmeal, in adult man and its influence on calcium absorption.

Calcium, iron and phosphorus balances and the degree to which phytin is hydrolysed within the intestine were determined on four adult subjects. The general pattern of the diet was made to conform, so far as possible under the conditions of the experiment, with that found by Cathcart, Murray and Beveridge[2] to prevail in the Scottish Highlands. To keep the calcium content of the diet low, cheese was eliminated and milk intake reduced. Since the oatmeal intake in the Highlands is lower to-day than hitherto the allowance was increased to bring it closer to that consumed in the Scottish Highlands during the last century[3]. This led to a corresponding reduction in flour intake.

In the first experiment the intake of calcium was 582 mgm. and that of phytin-phosphorus 574 mgm. daily. Almost all the phytin of the diet originated from oatmeal. Only 6 per cent of ingested phytin appeared in the fæces. When calcium lactate supplements were added to the diet phytin excretions increased; when a 200 mgm. calcium supplement was added to the diet the excretion increased to 8 per cent and, later, when 500 mgm. calcium were added 23 per cent of ingested phytin-phosphorus appeared in the fæces. The increases suggest that the added calcium decreased the solubility of phytin and thus reduced the opportunity for hydrolysis. The percentages of dietary phosphorus voided in the fæces were 34, 36 and 40 during successive experiments with increasing levels of calcium intake. When these phosphorus excretions were corrected for unhydrolysed phytin it was found that phosphorus absorption was within normal ranges. It follows, therefore, that the phosphorus of hydrolysed oatmeal phytin is as available as the non-phytin-phosphorus of a mixed diet.

So far as calcium absorption is concerned our results are inconclusive. To some extent this was to be expected since calcium itself was the variable and, consequently, detection of any influence of phytin on calcium metabolism would be difficult unless such an effect were most marked. The alternative approach of varying the phytin intake by changes in the oatmeal consumption would have introduced a multiplicity of variables. Two of the subjects on the basal diet showed normal absorptions while the remaining two subjects showed subnormal absorptions. In the case of the latter subjects improvement in absorption was associated with increased calcium intake. In the former subjects the addition of calcium lowered absorption somewhat. While these results do not decide the problem of whether oatmeal phytin interferes with calcium absorption, we would like to direct attention to the long-term study of Steggerda and Mitchell[4] who, in experiments designed to determine the calcium requirement of the adult, used a diet of low calcium content in which, incidentally, more oatmeal (284 gm. of oatmeal and oatcakes) was used than in our experiments. Notwithstanding the high oatmeal intake, Steggerda and Mitchell found the daily calcium requirement for equilibrium to be 9·2 mgm. per kgm. body weight, a value agreeing well with those of Leitch[5] of 10 mgm., Mitchell[6] of 9·75 mgm. and Outhouse *et al.*[7] of 10·7 mgm. Further, recalculation of the data of Steggerda and Mitchell shows that in their experiments calcium absorption was not interfered with by the phytin of oatmeal.

The absorption of iron was higher than that found by Widdowson and McCance[8] for subjects consuming brown bread diets.

The results reported in this note strongly suggest that the digestibility of phytin, and therefore probably its effect upon the absorption of minerals, varies from cereal to cereal.

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Supplies of Crystalline Vitamin D_3

In 1936, Windaus[1] and his co-workers isolated from the irradiation products of 7-dehydrocholesterol a dinitrobenzoate identical with the ester prepared almost simultaneously by Brockmann[2] from a concentrate of tunny fish-liver oil. The hydrolysates of these esters, though yielding no crystalline alcohol, clearly consisted of vitamin D_3 approaching purity. The crystalline vitamin itself was first prepared by Schenk[3] in 1937 from the irradiation products of 7-dehydrocholesterol. This isolation was described more fully by Windaus, Deppe and Wunderlich[4] in the same year. The same crystalline vitamin was prepared[5] in the following year from fish-liver oil.

A few grams of crystalline vitamin D_3, of German origin, became available in Great Britain before the War, for experimental work on animals[6] and man[7,8,9]. It was then clearly shown that clinically and in rat assays there was no significant difference between the antirachitic or hypercalcæmic activities of vitamins D_2 and D_3. The very limited quantity remaining after the completion of these experiments was set aside as a British Standard for vitamin D_3 (chick tests); since 1939, no further quantity of crystalline D_3 has been available in Great Britain.

During the last decade in these Laboratories we have had fairly extensive experience of the isolation and purification of calciferol, both on the laboratory scale and on the relatively large scale of fine chemical manufacture. During the last four or five years frequent, if intermittent, attempts have been made by us to apply these methods to the isolation of pure vitamin D_3. Even the addition of seeds of the German sample mentioned above failed to yield us any crystalline material.

It is only during the past few months that the matter has been attacked again more systematically, and we have now been able, after rigorous purification of the dinitrobenzoate, to produce several small batches of crystalline material that undoubtedly consists of vitamin D_3. One of these batches has been submitted to biological assay, and was found to have an activity slightly greater than, but not significantly different from, 40×10^6 I.U. per gram when assayed on rats by the usual line test procedure. All the batches had physico-chemical constants substantially the same as those claimed by the German investigators for the pure crystalline material.

We hope to prepare a series of larger batches, and to make a study of their physico-chemical constants, as well as of their biological activity, with the view of laying down a specification for the pure crystalline vitamin. Meanwhile, the small quantities of material at present in hand are available for research purposes and we should like this to be known to all workers in the vitamin field.

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Fermented Liquors in Old-time Cooking

THE riboflavin value found in ancient buns and ale (see NATURE, September 4, pp. 273–274) has an interesting historical background. Few people realize to-day the extent to which our ancestors used fermented liquors for all manner of domestic purposes.

Out of 516 early English recipes[1] (A.D. 1430–1450), ale, vinegar and wine are given as ingredients 306 times, often two or all three together and in considerable quantities. Barm and yeast (the latter presumably yeast strained from barm) were also used, apart from their normal function in bread and cakes. Fish was almost invariably cooked in ale, vinegar or wine, and mutton was stewed with all three.

In preparing "Mawmene"[2], a mixture of finely shredded pheasant, partridge and capon, often with the addition of pork or veal, wine was added six times, vinegar twice and ale once. The dish was not so alcoholic as it sounds; it was cooked for some time and most of the spirit would evaporate, but what subsidiary food factors were left behind ?

The sauces used by our ancestors had a base of crumbled bread mixed with wine, or vinegar, and flavoured with salt, pepper, mustard, cinnamon, cloves and other spices, and many of their meat dishes were sweetened with honey or sugar comfits. Relics of these are our bread sauce with game, red currant jelly with mutton and apple sauce with pork.

A recipe of Sir Kenelm Digby (A.D. 1669)[3] for stewing rump of beef says, "and put upon it about two quarts of good strong deep well bodied claret wine". The gravy must have been rather nice ! Sir Kenelm also used elder vinegar with turkey, capon, hare, pigeon and veal, and for fattening chickens recommends that their food should be mixed with ale and adds, "and let them have strong ale to drink".

At about this same period Hannah Woolly[4], a 'domestic science' expert of her time, guaranteed to cure scurvy by steeping scurvy-grass, wormwood, horseradish, red-dock root and various other herbs in five gallons of ale, the patient to drink a pint night and morning—approximately a three weeks course. It would be interesting to know the ascorbic acid value of that mixture.

Hannah Glasse[5] (A.D. 1747) used port and sherry on all possible occasions, stewed her steak in ale and, in a chapter headed "For Captains of Ships", gives a recipe for mushroom catchup to keep twenty years, which starts "Take a gallon of strong stale beer. . . ."

In the early eighteen hundreds, pickled herrings were still a national dish, great quantities were eaten, and there was a thriving Scottish trade in salmon pickled in vinegar, which was exported to the growing industrial towns of the south[6].

These delectable habits died rapidly during the second half of the nineteenth century. Quick transport from the developing railways, the drift of population to the towns during the Industrial Revolution, the growth of vast suburbs with cramped kitchens (later to become our slums), the invention of canning plus the demand of an industrial people for ready prepared foods, most of all, possibly, the ever-increasing excise on fermented liquors and the decline of home brewing—all these played a part in the change.

Whether the result has been for the nutritional benefit of the nation as a whole is open to grave doubt.

H. S. SARSON.

British Vinegars, Ltd.,
London, S.W.1.

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[1] Austin, "Two Fifteenth Century Cookery Books" (Early English Text Society, 1888).

[2] Harleian MS. 4016. "Here Beginnethe a Boke of Kokery".

[3] "The Closet of Sir Kenelm Digby, Opened" (1669).

[4] Woolly, Hannah, "The Queenlike Closet" (1670).

[5] Glasse, Hannah, "The Art of Cookery made Plain and Easy" 1747, and later editions).

[6] Beaufoy pamphlet, *circa* 1820.

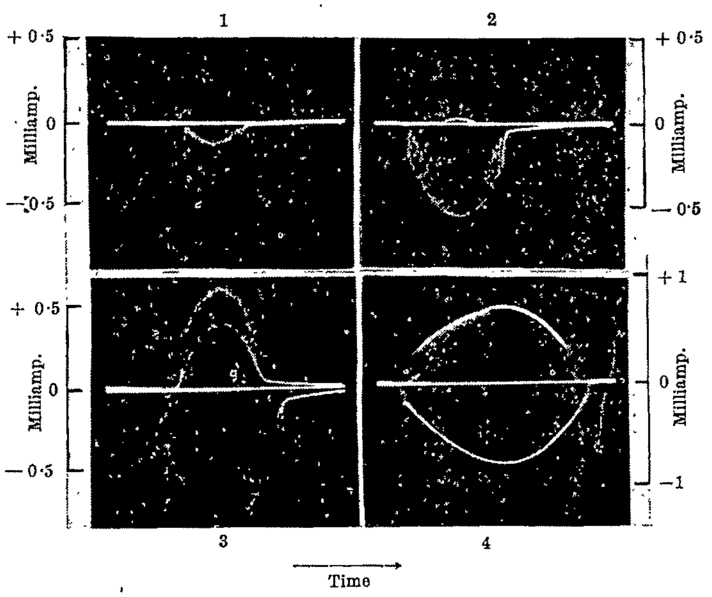
Initiation of Glow Discharges

THE form of the breakdown voltage/pressure curve for various gases in the pressure range 0–5 cm. mercury has been established by several investigators. The breakdown voltage usually measured is that at which a galvanometer in series with the experimental tube indicates a current of 0–1 microamp. This current increase is usually so abrupt (Druyvesteyn and Penning[1], p. 105 and Fig. 16) that the corona-starting voltage is defined within a range usually smaller than the accuracy of measurement. Huxley[2,3], Penning[4], Bruce[5] and Boulind[6], among others, have studied He,Ne[2] and N_2[3], A,He,Ne[4], H_2[5], and O_2, CO_2, H_2 and air[6].

There has been little published work dealing oscillographically with the breakdown processes at these pressures[7] (less than 5 cm. mercury). Considerable information is available for air at atmospheric pressures[8,9,10], and more recently, after our own experiments were started, data have been obtained for He, N_2 and A[11] at pressures down to 10 cm. mercury.

Owing to the present circumstances, the time available for our studies has been limited, and the gases used (H_2, N_2, O_2, A, Ne, CO_2, CH_4, air and CCl_2F_2) have usually been of commercial purity. Mercury contamination has been carefully avoided. However, the results obtained with these gases have been so varied and reproducible that some conclusions may be drawn for the pressures less than 3 cm. mercury. Also, the use of alternating current (50 c.p.s.), which is unusual in work of this kind, has been found advantageous and has led to certain improvements in technique. Other earlier workers[12,13] have used A.C. in corona studies carried out before modern methods were applied in this field. Care must clearly be taken in the interpretation of the results, so that effects due to the A.C. are not attributed to discharges in the gases. The A.C. results have, therefore, been checked frequently with D.C., and it is unlikely that any but very minor effects are due to the use of A.C. However, the persistence of metastable atoms in argon apparently causes small currents to flow during the positive half-cycles if appreciable currents are established during the preceding negative half-cycles. This causes the A.C. peak breakdown voltages in argon to be consistently less than the corresponding D.C. breakdown values; whereas in the other gases, the A.C. and D.C. breakdown voltages are identical, within the limits of experimental error. In accordance with the earlier work[4], negative breakdown precedes positive breakdown at the smaller electrode; the only exceptions we have found are oxygen and air at certain pressures in the counter, again confirming established data[6].

The use of a two-beam oscillograph, which allows



simultaneous observation of tube current and either tube voltage or a timing wave, has been found to be of great assistance.

Figs. 1–4 show the results for O_2 ($\sim$ 0·5 per cent N_2) at a pressure of 1·5 mm. mercury and a temperature of approximately 20° C. in a Geiger counter the copper cylinder and tungsten wire diameters of which were respectively 2·5 cm. and 0·127 cm. The resistance in series with the tube was approximately 1·9 megohms, except for Fig. 4, where it was 1·1 megohms. Variation of this resistance has often a considerable effect on the nature of the corona phenomena, as would be expected. Figs. 1–4 were taken respectively for tube voltages of 560, 640, 735 and 1,200 peak volts. At the lowest voltage only negative corona is present, in the form of negative streamers which, as the voltage is raised, eventually give place to a steady conducting state, in this case a self-maintained glow discharge. Positive corona appears initially as a continuous discharge (Fig. 2); positive streamers develop at higher voltages and are finally succeeded by a glow discharge (Fig. 4).

In some cases, streamers occur at breakdown and persist for an appreciable range of voltages. It would appear[14] that many of the authors cited above had made no allowance for this possibility in calculations involving the use of steady current values.

These experiments will be continued and extended, as circumstances permit, although it is inevitable that progress will be slow. It is hoped in particular to study the discharge in carefully purified gases and, extending Weissler's results, to observe the effect of the addition of quenching agents to gases in which metastable states appear[11]. Interesting features of the discharge centre round the Paschen minimum, where the effect of electrode materials will no doubt be important, and this region requires to be investigated further. The transitions between the various forms of the discharge, for example, from the streamer to the continuous glow, all require a closer investigation, and this will, of course, necessitate a careful study of the effect of the circuit parameters. Then, in addition to the low-pressure observations, it is hoped to observe the discharge effects at high gas pressures, in excess of atmospheric, some results for which have been obtained by Pollock and Cooper[15].

One of the valuable features of work on corona is the contribution to the better understanding of the fundamental processes which govern the propagation of discharge in gases and, in particular, photo-ionization. Such knowledge is necessary for the interpretation of many discharge phenomena, such as the spark, the mechanism of streamer development, and Geiger counter action.

Among other investigations which are of direct practical use to the engineer, and which we hope to continue, is the study of corona in various types of engineering apparatus, where corona may take place either in a gas, liquid or solid dielectric. Similar work on the onset of ionization has been reported by Quinn[16].

We are indebted to Dr. A. P. M. Fleming, director of the Research and Education Departments, Metropolitan-Vickers Electrical Co., Ltd., for permission to publish this note.

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Aug. 24.

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[2] Huxley, L. G. H., *Phil. Mag.*, **5**, 721 (1928).
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[4] Penning, F. M., *Phil. Mag.*, **11**, 961 (1931).
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Future of Technical Colleges

WE have read with interest the communications by Mr. E. B. Moullin[1] and Dr. H. Lowery[2], which comment upon our letter[3] on this subject. These letters fail to offer further constructive suggestions, and we therefore focus attention again upon some essential and immediate needs of technical education, particularly in the advanced sphere, and upon a scheme for their fulfilment. We would urge that so far as possible, discussion should be concrete and definite. It is not enough to speak vaguely of ideal systems, people's university, etc., without specifying what is meant, or how to attain this ideal.

It has been contended that[2] in relation to the total number of students receiving technical education, there are not many who require advanced training in applied sciences, technology and commerce. The *absolute* numbers, however, are not small, and are steadily growing. In the present chaotic organization of technical education, whereby both advanced and elementary students are frequently housed in the same college, the great numbers of elementary students statistically outweigh the advanced students. Imagine the same system to operate in the university sphere, with elementary education and also advanced academic studies in the same building. From the point of view of numbers, the elementary students would again numerically far outweigh the advanced students. In fact, in the technical colleges as in the universities, and for the same reasons, the advanced work is of vital importance. We would again urge the creation of higher technical colleges in which the advanced work at present in existence may be concentrated. The major colleges might be fed partly by satellite colleges, and also by technical schools, evening institutes and schools, just as the universities are now fed by the high schools, grammar schools and public schools. The advanced work at present done by the technical colleges, particularly on the research side, is inadequate ; but with the suggested arrangement a growth of advanced technology and research becomes possible.

The new higher technical colleges, or institutes of technology, functioning along these lines, with generous financial backing by the State and, we would hope, by industry, have a vital part to play in maintaining the place of Great Britain as an industrial country. We would again point out, since this great but remediable weakness in our technical education system has not been emphasized sufficiently, that the apex of technical education, as understood in America and the Continent, and exemplified in their institutes of technology and *technische Hochschulen*, is almost entirely lacking in Great Britain. One reads, moreover, that Britain spends only a very small fraction *per caput* of the American and Russian expenditure on technical education. To hold our own in post-war industrial development requires great and unremitting efforts on our part. Nowhere can we begin better than by sorting out our technical education system, concentrating the various grades of work in appropriate institutions, and by creating some institutes of technology on the American pattern.

We are loth to make an issue of external examination systems. As a means of obtaining high qualifications in technology, we believe that the external degree system has rendered important service to Great Britain, whatever has been said to the contrary by those who disparage degree work in technology in the technical colleges. We make the further comment that before the external degree could be displaced it would be essential that an internal examination *accepted nationally by industry and commerce* as giving qualifications at least of equal standing should be *actually in existence* to take its place. We know of no such examination which is even remotely able to substitute for the external degree examination in giving an all-round qualification in the various applied sciences. One can therefore see that any attempt to suppress this system constitutes a serious threat to training in advanced technology in technical institutions. This threat comes, moreover, at a time when we should be making every effort to expand and develop all branches of technical education, particularly the advanced work.

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[1] NATURE, 152, 191 (1943).
[2] NATURE, 152, 218 (1943).
[3] NATURE, 152, 80 (1943).

DR. LOWERY's letter in NATURE of August 21 contains several statements which cannot be allowed to pass unchallenged.

Referring to degree courses, he writes, "It is not right, however, that the coaching of a relatively few people for examinations run by an outside body . . . should come to be regarded as the highest function of a technical college and should unduly influence its educational aims". I am quite certain that, in general, it is not so regarded either by technical colleges or by the members of the public who know of their work, and the implication that this small volume of work unduly influences the educational aim of colleges is quite incorrect. Further, he states, "Degree courses in technical colleges are makeshift courses", but Dr. Lowery is quite well aware that there are many technical colleges where the degree courses are not makeshift courses but are properly organized courses conducted by staff, and with equipment, not inferior to some universities. Dr. Lowery should in fairness to these colleges have qualified the sweeping character of his statement.

The question of the desirability of technical colleges conducting any degree courses may be debatable—though the real debatable point is should there be such a thing as an external degree—but to imply that technical colleges are "tending to neglect their most important work" partly as a result of "flirting" with university education is to convey a wholly misleading picture of the technical colleges in Great Britain. The splendid work of these colleges, related directly as it is to the needs of industry, has been a factor of the greatest importance in our industrial development.

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THE attention of the Council of this Association has been directed to a letter from Dr. H. Lowery which appeared in NATURE of August 21, p. 218. In this the writer states that: "Degree courses in technical colleges are makeshift courses, and have grown out of a makeshift system".

While it is true that these courses have grown, as indeed the universities have themselves, from small beginnings, the statement that the degree courses in the technical colleges of Great Britain are makeshift is quite untrue and a damaging statement as regards many important colleges in both London and the provinces.

In London, several of the polytechnics are recognized for *internal* degrees of the University of London in a number of subjects. Actually, about 44 per cent of the students who obtain the internal degrees in engineering carry out their courses in polytechnics and not in the University itself, while in science the percentage is about 27.

There are also a number of well-equipped and adequately staffed technical colleges in the provinces which have been carrying on degree courses successfully for many years. These courses are in every way as satisfactory as those in the universities themselves.

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(President.)
D. HUMPHREY.
(Hon. Secretary.)

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PRECISION HYGROMETRY WITH A WET-BULB

By Dr. W. LAWRENCE BALLS, C.B.E., F.R.S.
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A METHOD was required whereby the relative humidity (R.H.) of air in equilibrium with cotton samples could be determined to one half of one per cent. The apparatus had to maintain its zero and its calibration year in and year out, so as to make it suitable for routine employment in a testing laboratory. Certified thermometers which are used within the limits of ordinary room temperature changes can fulfil this condition, so the wet-and-dry-bulb method was investigated and improved until it became precise. So far as cotton-testing is concerned, the work is at present in suspense, but the wet-bulb hygrometer was tried out during a couple of years and seems to merit description.

The following are the essential components. An aspirator, which is a diaphragm-type variable speed air-pump, is required if re-circulation of the air is needed. The temperature of the air at the sampling point is noted by a thermometer mounted with its bulb concentric to the intake of the aspirator. This air then passes through a long coil of copper tube immersed in a water-bath, where it comes to the temperature of the water and so almost stabilizes the next reading to be taken, that of the dry-bulb proper; incidentally, this minimizes reading errors on the dry-bulb. This partial stability is only due to the large volume of the water-bath (about ten litres), its temperature not being regulated at all; obviously, if its temperature is below the dew-point of the incoming air, warm water must be used. The wet-bulb and dry-bulb thermometers are mounted inside two vertical and parallel glass encasing tubes, sealed below and stoppered at the top, with side-tube inlet, side-tube exit, and a side-tube connexion between them. The lower ends and the side-tubes are all immersed in the water-bath, thereby helping to screen the thermometer bulbs from external radiation. Air coming from the copper pipe impinges on the dry-bulb at right angles through the inlet tube, then passes through the interconnecting tube; cemented inside this is a stainless steel liner which standardizes its diameter and hence the rate of flow at which the air impinges on the foot of the wet-bulb in the other encasing tube. The air escapes from the latter through the exit side-tube, which is similarly lined, but with a stainless steel tube of slightly smaller diameter; thus a small air pressure is built up in the wet-bulb encasing tube; this exit tube is aligned to withdraw the air from the top of the wet-bulb wick, so giving very turbulent air-flow over the wick at a known final velocity; actually six metres per second is used. The volume of air passed through or around the circuit is indicated by a venturi throat inserted therein with an inclined mercury manometer attached; this is calibrated by direct collection of the air discharged and adjusted by inclining the manometer so that a single marked point thereon indicates six litres per minute in our particular lay-out; if the reading is off this marked point, the pump-speed is regulated accordingly.

Certain precautions are taken in the use of these essential components. The encasing tubes and venturi meter are enclosed in a glass-fronted cupboard resting on top of the water-bath tank; the roof of the cupboard is hinged for access to the encasing tubes. Thermometers of the sling-psychrometer type are used, with small cylindrical bulbs, taking less than two minutes to reach equilibrium; the lapse of this time is most conveniently indicated by using a sand-glass, to avoid confusion of thermometer figures with clock figures in rapid working. This type of thermometer was more easily obtained in Fahrenheit calibration, and is read to estimated tenths of a degree Fahrenheit in order to get the accuracy required; this is done by simple lenses in anti-parallax mountings, which slide on the glass cupboard-front. It having been found that confusion was liable to happen between tens and fives on the scale of degrees when reading through lenses, the thermometer stems were painted red from 65 to 70, 75 to 80, and so on. A very convenient standard wick was adopted by removing the braided cotton cover from electric wiring flex of suitable size; this was boiled in caustic soda and washed with distilled water while stretched on glass tubing of the same diameter as the thermometer bulb; after drying, it was cut into lengths slightly longer than a bulb, slipped on the bulb and slightly stretched to make it hold closely.

With the apparatus thus set up, and using appropriate tables or graphs, we first obtain the 'grams of moisture per kilogram of air' from the depression of the wet-bulb, and then refer this to the temperature of the intake thermometer, so finding the relative humidity at the intake. The standard error of the determination is dependent on reading the thermometers to one tenth of one degree, and so is greater with damp cold air than with hot dry air; this error can be reduced by using a warm water-bath, and in average conditions is less than $\frac{1}{2}$ per cent R.H. The absolute accuracy of the result, as distinct from the relative accuracy with which we were immediately concerned, is necessarily contingent on the accuracy of the tables of hygrometry. In the last resort, these should be worked out anew for the particular instrument design employed, with the correct air-speed.

However, the lay-out described, though completely standardized, can only be effective if the evaporating abilities of the wick itself are also standardized, and the technique whereby the wick-properties are stabilized over periods of a year and more constitutes our principal improvement in wet-bulb hygrometry. It has been noted by meteorologists that wet-bulb wicks deteriorate during use, the depression becoming less than it should be. This had been ascribed to dust and dirt adhering to the wick. A weekly change of wick is routine in some meteorological screens. Using our apparatus under the very stringent conditions of cotton-air-moisture determination checked against actual oven-tests, on many samples every day, we found at first that a weekly change of the wick sufficed. But this was during the winter, in Alexandria, and as the observations continued into the hot weather we found evidence of wick deterioration arriving more rapidly, until by June the results were falsified even by the second day of use. This suggested a biological factor in the deterioration.

The encasing tube of the wet-bulb thermometer was therefore expanded into a biggish bulb at the bottom, this bulb being completely immersed in the water-bath, and itself filled with a 0·1 per cent solution of mercuric chloride, as an antiseptic against bacteria and fungi, which nevertheless was so dilute as not to behave unlike pure water during short runs. The stopper at the top of the encasing tube was expanded into a glass saucer, closed by a thin and slack rubber diaphragm from toy balloons. The wet-bulb thermometer was suspended from this diaphragm with appropriate stops to limit its range of up and down movements. Normally it remained with its bulb immersed in the mercuric chloride solution. When the air-pump was started the small pressure built up in the encasing tube caused the diaphragm to distend; this lifted the thermometer with its dripping wet wick into the turbulent air-flow and held it steady in position ready for reading after two minutes had elapsed. The wicks used will hold the depression constant for some five minutes or more, according to conditions, before they show signs of drying up. The evaporation from the solution is negligible except while the air-stream is flowing, and it is then of the order of three milligrams of water per test, so that the solution has eventually to be topped up with distilled water; actually about once a week when in continuous daily use. The relative humidity of the outgoing air is perceptibly increased by this added water, which is immaterial unless re-circulation is employed, when small corrections become necessary, dependent on the volume of air in the system.

The stability of the system over long periods of time, and its low standard error, are its outstanding advantages. Its accuracy would seem to be of the same order as that of the more difficult dew-point determinations. Additionally, it is often very convenient to be able to place the intake in some particular locality, with a long rubber tube to the apparatus, and examine the humidity in different parts of a room, or underground in the soil, and so forth.

ROYAL PHOTOGRAPHIC SOCIETY'S ANNUAL EXHIBITION

THE eighty-eighth Annual Exhibition of the Royal Photographic Society of Great Britain was opened on September 3 by H.R.H. King Peter of Yugoslavia. The Exhibition is being held at the Society's premises at 16 Princes Gate, London, S.W.7, and will be open to the public between 10 a.m. and 5 p.m. until October 23 inclusive. A new experiment being tried this year is Sunday opening. The Exhibition is being opened on alternate Sundays, September 12 and 26 and October 10 from 2 p.m. until 5 p.m. This is to enable members and others who, on account of their war work or other causes, are unable to travel or find time to see the Exhibition on weekdays.

The Exhibition, as is usual, covers all branches of photography from the purely pictorial to the use of photosensitive material in research. While one cannot but admire some of the pictorial work and note that both the quantity and quality of previous years seem well maintained, one can regret that the same cannot be said of the 'scientific' exhibits. The best represented section is probably "Natural History", in which are shown many fine examples of wild life (both plant and animal) in their natural habitats. The War has evidently had little effect on the patience of the photographer of Nature.

Colour photography also seems to have suffered little, being represented by a number of prints on paper some of which are of excellent quality. Many transparencies are shown, including one case of "Scientific Colour Transparencies" which are mainly of biological subjects, or photomicrographs by polarized light.

Of special interest this year are two exhibits in the Trade Section. One is on mass miniature radiography by Ilford Limited and the other on the 'Kodak' transfer sensitizing process. The attack on tuberculosis depends for its success on early diagnosis, so that the possibility of mass miniature radiography should be a milestone on the road to the control of the disease. In the absence of means of refracting or specularly reflecting X-rays it has been generally necessary to obtain full-size pictures of the subject. Quite apart from the cost of such large photographs as are necessary when dealing with the human chest, the handling of large numbers of 15 in. × 12 in. films becomes a serious matter. The possibility of photographing, with an ordinary camera and film sensitive to light, the fluorescent image produced by X-rays falling on a fluorescent screen was shown many years ago, but it has only relatively recently been possible to reduce this process to one of routine requiring only a short exposure of the patient to X-rays. This development has been due largely to the increase in aperture of lenses and the increase in speed of photographic film. The image of the chest is contained in an area of film only one inch square, so that a large number can be accommodated on 35 mm. cine-film which can be easily handled in any length.

Mass miniature radiography units have been developed and have been adopted by the Ministry of Health for national service purposes. The equipment and method of working is illustrated in detail by pictures and models. It must be emphasized that the method is not intended as one for diagnosis but to enable a large number of presumably normal individuals to be examined to detect unsuspected abnormalities which can, where necessary, be the subject of full-scale radiological and clinical examination.

The exhibit by Kodak Limited is of the 'Kodak' transfer sensitizing process by means of which any flat sheet material can be sensitized. The chief application is in the marking of templates. The conventional method consists in hand-scribing the design from a scale drawing, which requires a skilled and experienced operator. By the method illustrated the material on which the template is to be marked is first lacquered and the sensitizing paper is then squeegeed to it by means of a roller squeegee. The temporary paper support is stripped off when the sensitive surface is required for use. The required design may be drawn on translucent paper, or should the original drawing be on an opaque support an intermediate negative is necessary or the 'reflex transfer' process may be used. The exposed layer is then developed on the metal or other support to yield an image of the required design.

The process is illustrated by a series of specimens contributed by Handley Page, Ltd., including an 8 ft. × 4 ft. metal section bearing designs reproduced by this process.

The process also lends itself to the production of such things as name-plates, instrument dials, etc. Direct use may be made of the photographic image, but more robust forms may be made by converting the image into a gelatin stencil which allows the undercoat lacquer to be dissolved away, leaving the design in lacquer, or the bared metal may be plated or etched and filled. Typical examples of this application are shown by Marconi Instruments, Ltd., and The Accurate Recording Instruments Co.

Having dwelt at some length on only two of the exhibits may give the impression that there is little else to be seen. This is not so. The pictorial prints, lantern slides and stereoscopic transparencies are themselves worth a visit and can be relied upon to provide agreeable relaxation.

A SURVEY OF CANADIAN SCHOOLCHILDREN

THE statistical results of a survey of children in the elementary schools of the city of Toronto, taken in November 1939, have recently been published*. It is a team work in which the Hospital for Sick Children in Toronto, the Department of Pensions and National Health, Ottawa, the Education Statistics Branch of the Dominion Bureau of Statistics, and the Toronto Board of Education participated. The whole report is the work of Mr. N. Keyfitz and his assistants of the Social Analysis Branch of the Dominion Bureau of Statistics.

In 1923 the Department of Public Health in Toronto made a survey of 59,000 elementary pupils, from which a table of average heights and weights by age was calculated and which became the standard for Canadian school-children. During the intervening sixteen years it was found that, as a result of the policy of social improvement based on the previous findings, pupils in the various age-groups were outgrowing their categories, and it was decided to institute a new survey in which medical investigation would be as thorough as possible and the correction of physical defects would be a major aim.

In the present study of 78,000 children, equally divided on the basis of sex, emphasis is laid on the influence of such factors as economic status, birthplace of parents and the range within which nutrition affects the build of children. An effort is made throughout to determine the relative importance of the following points: (1) Does the economic status of the family influence the prevalence of disease and defect? (2) Does it retard the child in his academic standing as indicated by his school grade? (3) Do certain combinations of defects or diseases have more effect on the height and weight than the same defects and diseases unassociated? (4) How does heredity as shown by parental birth-place affect build?

The pupils of 1939 are found to be taller for their age than similar groups of 1923, except the six-year-olds. This may be explained by the fact that it is now customary to enter children at school at six, while formerly less robust six-year-olds were kept at home. Girls are found to mature earlier than boys; but thirteen-year-olds of the latter are found to mature at two different rates, as shown by a bimodal distribution representing maxima in height and weight combined.

An interesting comparison between the Toronto survey and Sir Frederick Menzies's London survey of 1938 is made. Canadian children, as one would expect, are taller than English ones. The London children of 1938 approximate in height and weight the 1923 levels of Toronto. However, the differences between the well-to-do and poorer metropolitan boroughs show the same tendencies as the Toronto ones, the differences being, if anything, less marked in England. A similar extensive study by the U.S. Department of Agriculture (Garment and Pattern Construction) in 1941 of 147,000 white schoolchildren of 4–17 years of age is remarkably close to the Canadian figures.

Economic status of parents: It is found that unskilled labourers and unemployed parents have children who are under-height; but there is striking absence of differences in build, that is, weight in relation to height, between children from poor and prosperous districts.

Diseases and defects: Diseases have no appreciable effects on height and weight, but defects tend to make their owners shorter and lighter for their height, that is, thinner.

Heredity: Children of United States-born parents are taller, and those of British-born parents are lighter than those of Canadian-born parents. Inter-racial marriage tends to increase the height of offspring. Children whose parents are eastern European-born are taller and those whose parents are of western European birth are shorter and heavier.

It is, of course, well known that foreign-born immigrants tend to be in less skilled occupations, while United States-born are often in a higher economic level than the Canadian-born.

The work is lavishly illustrated with charts and tables but one feels, after all is said, that fewer tables and a more detailed discussion of the biological principles governing growth would make this excellent booklet more valuable and instructive. Nevertheless, in these days when the very basis of science is being challenged, and men of science are everywhere engaged on the destructive aspects of their calling, it is refreshing to come across a progressive little book of the type, at once creative and far-sighted.

R. E. G. ARMATTOE.

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* A Height and Weight Survey of Toronto Elementary School Children, 1939. Pp. 36. Published by authority of the Hon. James A. MacKinnon, M.P., Minister of Trade and Commerce. (Ottawa, 1942.) 25 cents.

RADIO DETECTION AND RANGING

'RADAR', the code name for radio detecting and ranging, has been officially revealed to be one of the foremost scientific developments of the War, according to a statement issued by the Western Electric Co. (*Bell Lab. Rec.*, 21, No. 10; June 1943). An electronic instrument projects a beam of radio impulses, and these impulses reveal the presence of distant objects by rebounding to the observer. When trained on enemy aeroplanes, still so distant as to be beyond the reach of anti-aircraft guns, 'radar' reports their presence. The system is, of course, unaffected by darkness, clouds or fog.

Under the name of radiolocation the method was credited by Lord Beaverbrook with winning the Battle of Britain. In the South Pacific, according to the article in the *Bell Laboratories Record*, it has been responsible for enemy losses of millions of dollars' worth of ships, aeroplanes and submarines. Radar was developed on the basis of years of research and experiment in electronics, independently in the United States and Great Britain, and credit for the development must be shared by many of the foremost scientific men of the two nations.

The fact that radio waves can be reflected just as can light and sound waves had long been known and the phenomenon had been used, for example, to measure the electrical reflecting surface in the ionosphere. Only with the advent of the ultra-short radio waves in the early 1930's did it become possible to observe reflexions from objects so small as an aeroplane. In 1932, it was noticed that an aeroplane flying about 1,500 ft. overhead produced a noticeable 'flutter' of about four cycles per second. In 1938 the absolute altimeter was introduced commercially for use in aircraft. This instrument employed the principle of directing radio waves against the ground and timing their return to give the exact height of an aircraft above the earth. In the same year, in the United States, a series of experiments at 15th Street in Brooklyn overlooking the Narrows leading into Manhattan's upper bay was made, using a modification of the absolute altimeter enclosed in a hornlike directional antenna system of galvanized sheet, and it was observed that radio waves directed against ships passing through the Narrows were thrown back into the receivers.

With the formation in the United States of the National Defense Research Committee, 'radar' became one of the most active lines of investigation by a large group of scientific workers. A mission of British men of science to the United States made a complete disclosure of the status of their art, with reciprocal disclosures by the N.D.R.C. group. Still in limited use in the U.S. Armed Forces when the United States entered the War, 'radar' is now standard equipment for both American Army and Navy. An official statement says of it, "radar is used by static ground defences to provide data for anti-aircraft guns for use in smashing Axis planes through cloud cover, and by airplanes and warships".

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public.)*

Saturday, October 2

Association of Scientific Workers (at Essex Hall, Essex Street, Strand, London, W.C.2), at 2.30 p.m.—Conference on "Problems of Freed Europe—The Challenge to the Medical Sciences". Problems of the Occupied Territories: Belgium (Dr. A. Marteau); Czechoslovakia (Dr. V. Kruta); Greece (Dr. A. P. Cawadias); U.S.S.R. (Prof. S. A. Sarkisov); Present Plans for Relief (Prof. J. R. Marrack).

Geologists' Association (at Geological Society, Burlington House, London, W.1), at 2.30 p.m.—G. S. Sweeting: "Wealden Iron Ore and the History of its Industry".

Monday, October 4

Society of Chemical Industry (London Section) (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Mr. S. J. Johnstone: "The Organisation and Use of Technical Intelligence Services".

Tuesday, October 5

Royal Anthropological Institute (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—Dr. Margaret Mead: "Modern Anthropology".

Chadwick Public Lecture (at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London, W.1), at 2.30 p.m.—Mr. E. J. Boome: "Muscular and Mental Relaxation in Peace and War".*

Society for the Study of Inebriety (in the Meyerstein Lecture Hall, Westminster Hospital Medical School, Horseferry Road, London, S.W.1), at 4 p.m.—Dr. A. Ninian Bruce: "Alcohol and Avitaminosis" (Nineteenth Norman Kerr Memorial Lecture).

Society of Chemical Industry (Manchester Section) (Joint Meeting with the Manchester Literary and Philosophical Society) (in Room 7, The University, Oxford Road, Manchester), at 5.30 p.m.—Sir John Russell, F.R.S.: "Agricultural Reconstruction in Europe after the War".

Thursday, October 7

Institution of Electrical Engineers (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Colonel Sir A. Stanley Angwin: Presidential Address.

Friday, October 8

Royal Astronomical Society (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Mr. H. W. Newton: "Solar Flares and Magnetic Storms".

Saturday, October 9

Sheffield Metallurgical Association (Joint Meeting with the Microchemical Section of the Society of Public Analysts and the South Yorkshire Section of the Royal Institute of Chemistry) (in the Department of Applied Science, The University, St. George's Square, Sheffield), at 2.30 p.m.—Symposium on "Microchemical Analysis".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Chair of Social Medicine—The Secretary, The University, Edmund Street, Birmingham 3 (March 1).

University Lecturer in Anthropology—The Secretary of the Appointments Committee of the Faculty of Archæology and Anthropology, Museum of Archæology and of Ethnology, Cambridge (April 15).

Head of the Department of Dyeing in the Bradford Technical College—The Director of Education, Town Hall, Bradford (October 9).

Lecturer in Physiology and Zoology—The Registrar, Technical College, Sunderland (October 9).

Lecturer (woman) in Biology in the Department of Pharmacy and Biology—The Principal, Central Technical College, Suffolk Street, Birmingham 1 (October 9).

Educational Psychologist—The Chief Education Officer, Education Office, Warrior Square, Southend-on-Sea (October 11).

Research Histologist (non-medical) in the Pathological Department—The Secretary, Royal Cancer (Free) Hospital, Fulham Road, London, S.W.3 (October 13).

Teacher of Mathematics and Physics in the Junior Technical School and Senior part-time Classes of the Batley Technical College—The Director of Education, Education Offices, Batley, Yorkshire (October 15).

Assistant Electrical Engineer for the Nigerian Government Public Works Department—The Secretary, Overseas Manpower Committee (Reference No. 538), Ministry of Labour and National Service, Alexandra House, Kingsway, London, W.C.2.

Assistant Mechanical Engineer for the Electrical Branch of the Nigerian Government Public Works Department—The Secretary, Overseas Manpower Committee (Reference No. 1076), Ministry of Labour and National Service, Alexandra House, Kingsway, London, W.C.2.

Mechanical and Electrical Engineer for the Gold Coast Government Public Works Department—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, "D" Section, D.588X, Alexandra House, Kingsway, London, W.C.2.

Engineer and Manager of the Inverness Corporation Electricity Department—The Town Clerk, Town House, Inverness (October 11).

Assistant Master to teach Science, with an Engineering bias, and Practical Mathematics, in the Forest of Dean Mining and Technical School and East Dean Grammar School—The Secretary, County Education Office, Shire Hall, Gloucester.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh. Section B (Biology). Vol. 61, Part 4, No. 30: Study of an Introduced North American Freshwater Mollusc, *Stagnicola catascopium* (Say). By D. Keith McE. Kevan. Pp. 430–461. (Edinburgh and London: Oliver and Boyd.) 2*s.* 9*d.* [308

Scientific Proceedings of the Royal Dublin Society. Vol. 23 (N.S.), No. 15: The Chemical Constituents of Lichens found in Ireland—*Lecanora gangaleoides*, Part 3: The Constitution of Gangaleoidin. By Dr. V. E. Davidson, Dr. J. Keane and Dr. T. J. Nolan. Pp. 143–164. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 2*s.* [308

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the Annual Visitation of the Royal Observatory, 1943 June 5. Pp. 14. (Greenwich: Royal Observatory.) [308

Other Countries

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 158: The Recovery of Inter-Block Information in Quasi-Factorial Designs with Incomplete Data, 1: Square, Triple and Cubic Lattices. By E. A. Cornish. Pp. 22. Bulletin No. 159: Poisonous and Harmful Fishes. By G. P. Whitley. (Division of Fisheries, Report No. 10.) Pp. 28+3 plates. Bulletin No. 161: A Review of the Evidence concerning Expansive Reaction between Aggregate and Cement in Concrete. By Dr. A. R. Alderman. Pp. 19. (Melbourne: Government Printer.) [178

Queen Victoria Memorial, Salisbury, Southern Rhodesia. Annual Report for the Year ended 31st March 1943. Pp. 10. (Salisbury: Queen Victoria Memorial.) [178

Association of Scientific Workers of Southern Africa. Research Memorandum No. 1: Marine Biological Research and the South African Fishing Industry. By Wm. Edwyn Isaac. Pp. 16. (Cape Town: The African Bookman.) 1*s.* 6*d.* [178

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EDUCATIONAL RECONSTRUCTION

GENERAL REVIEW

IN NATURE of July 31 we published an article bearing the above title, and arising immediately out of the White Paper which had been presented to Parliament by the President of the Board of Education. The article was in the main expository and explanatory, further comment being expressly reserved for a later date. On the present occasion we give a general account of the situation as seen after some months of discussion in the country, and in following issues we hope to discuss special aspects of the comprehensive contents of the White Paper.

For a comparable effort to deal with education on a national scale, we have to go back to the year 1870, when W. E. Forster took the lead in the passing of the first Elementary Education Act. His declared object was to complete the existing voluntary system and to "fill up the gaps". His Bill was well received, but second thoughts on the part of his own political associates proved disastrous. As one turns over the pages of Hansard, one marvels at the melancholy tale of denominational jealousies and suspicions, and even though the lapse of seven decades has softened asperities, one is impressed with the wisdom of Mr. Butler's patient and cautious method of approach. The stern warning was repeated in 1902, when Balfour's measure established rate-aid for voluntary schools and along with it the dual system of control—opposed with all the bitterness of 1870, and still, as the White Paper shows, the chief stumbling-block in the path of the reformer. The other outstanding measure, that of 1918, conceived in a very different atmosphere, and at first supported with enthusiasm, remains to this day in great part a dead letter, as regards its socially significant provisions, namely, those relating to youth and to nursery schools. No wonder that, with this premonitory instance plain to be seen, the "exceeding lack of speed" in the proposals of the White Paper should have alarmed many of the firmest friends of education. They quite agree with the White Paper that laws cannot do everything, that laws "cannot build better human beings", and that "it is not the machinery of education so much as its content that will count in the future" ; but they remember also that the law's delays can do an infinite deal of harm. There is little doubt that we shall hear more of this when the Education Bill comes before Parliament.

From the broadly national point of view taken in this article, the most far-reaching statement in the White Paper appears unobtrusively and almost incidentally in paragraph 27 : "The key-note of the new system will be that the child is the centre of education and that, so far as is humanly possible, all children shall receive the type of education for which they are best adapted". The child the centre of education ! Of course no originality is claimed for this declaration. That the child is the true and only centre of education has for centuries been the merest commonplace in the best educational thought. Nor can it be claimed that it now appears for the first time in an official document, for it was the key-note also of Morant's famous introduction to the Code of 1904. Through his instrumentality, the child, not the official nor the tax-payer, nor even the teacher, was for the first time envisaged as the central figure in the educational scene, for whom, and for whom alone, that scene exists. The late Sir John Adams used to say that you had to hammer away for at least fifty years to secure a reform before anyone even began to listen; and was it not the late Lord Balfour who said that democracy must be led, not driven, but that it takes a lot of leading? When, however, democracy has made up its mind, the thing is done, and done far better than as the result of an autocratic decree. Let us hope that on this point our democracy has at last made up its mind.

Most of what follows will be in the nature of corollaries to this basic proposition. Large classes, for example, are condemned on the fundamental ground that they are bad for the child. "No teacher, however competent, can see to the development of an individual child's innate potentialities, or foster in it a healthy development of mind, body and character, if she has to deal single-handed with a class of 50 small children. This is not education but mass production" (par. 16). Large classes are always and necessarily bad for the child, though not obviously so for the teacher. For there is a type of teacher who can quite as easily manage fifty children as a dozen, and may indeed be happier with the fifty. But though he may please a superficially observant inspector or other visitor, he is not a good type of teacher, for the simple reason that he is satisfied with mass production. Large classes make it impossible for *any* teacher to meet the needs of the individual child—and that settles the matter.

The formula seven-to-eleven as the period to be spent in the junior school may commend itself to a person who surveys the educational scene from an office window. But it is in reality nothing but an administrative convenience. No scientific student of child nature, and indeed no close observer whatever, could approve of such a denial of the fact of individuality. Furthermore, the institution of an examinational test at the age of ten or eleven has had disastrous effects upon the aims and methods of the junior school, especially where competition for admission to secondary schools has been keen. Again, the White Paper takes the child's point of view, not that of the administrative machine—and the competitive examination goes. So also does the absurd assumption that any child's future development can by any imaginable means be safely foretold at the age of ten or eleven.

We have not observed that the proposed abolition of the examination at or before the age of eleven has called forth any lamentations. That is not quite true of the Norwood Committee's recommendation that the purely external examination for the school certificate should, "in the interest of the individual child and of the increased freedom and responsibility of the teaching profession", be gradually modified out of existence. Nothing could in point of fairness be better than the Committee's statement of the *pros* and *cons*, but its verdict is emphatic. Much of the opposition seems to have come from the men teachers, who are commendably anxious for the reputation of the certificate. The arguments employed are strongly reminiscent of the controversy which led to the present position in the University of London. Those arguments have in them a flavour of the nineteenth century, when the external examiner held universal sway, from the lowest to the highest of educational institutions. Let it be noted that the Committee's recommendation is in perfect accord with the White Paper. It is based upon "the interest of the individual child". The addition "and the increased freedom and responsibility of the teaching profession" is at bottom only another way of saying the same thing.

Coming now to the inevitable "religious difficulty", we note that in some quarters disappointment is expressed that the dual system of control is to be allowed to survive. For ourselves, we strongly suspect that if the matter could be left to the teachers and parents there would soon be an end of the difficulty. But we recognize that the whole history of our educational past is against that solution, and we can no more get away from that past than a man can get away from his own shadow. We are therefore left to admire the tact and patience with which Mr. Butler has handled his thorniest problem, and to express the hope that the intransigents, both of the Left and of the Right, may on this occasion sing small—again for the sake of the children of England. We observe also that many teachers are not so sure of the agreed syllabus being a sovereign remedy as the White Paper appears to assume. They reasonably point to the Board of Education's practice of issuing *suggestions* on the teaching of various subjects, a practice which is highly valued by the teachers, and they say that if an agreed syllabus is put forward as a suggestion rather than a mandate it would also be welcome. We are inclined to think that that is precisely the way in which an agreed syllabus will be viewed and utilized by a thoughtful teacher, who will reserve to himself a certain liberty of interpretation. The teacher may, we think, safely accept the agreed syllabus as representing at any rate "the next step".

The new system, the child-centred system, of which the White Paper speaks, falls into three stages—primary, secondary, and further education. To begin at the beginning, the nursery-school movement is excellent so far as it now goes. It is the outcome of the wisdom and enthusiasm of such persons as the McMillan sisters. The quality is there, but as to the quantity, nearly everything remains to be done, and there is no social problem more urgent. The proper aims of the primary school are well set forth in the Paper, but we are faced with the fact that even in places where re-organization has been arranged, the primaries are too often housed in buildings that make those aims impossible to realize. As for the secondary stage, the grammar schools, of course, we have with us, with their good record of achievement during the past twenty years, predominantly on academic lines. That those lines now need radical revision is strongly urged by critics who are by no means lacking in respect for tradition. They value the Norwood Report for its enunciation of principles, but contend that those principles are not carried to their logical conclusion in the recommendations as to curricula. Preparation for post-war citizenship calls, as we have said, for radical revision, but the Norwood Report tacitly asserts that the old bottles are safe containers of the new wine. This will never do. As for the modern schools, the White Paper waxes almost lyrical in describing their possibilities, and it is well to have the ideal set forth in an official document which has secured general approval. But the drab reality is that in respect of buildings, equipment, staff and 'amenities' nearly everything remains to be done.

We recite these examples, to which others may be added in subsequent articles, not indeed as a counsel of despair, but rather as an explanation of the deep concern expressed by educationists at the "excessive lack of speed" which the White Paper seems to view with complacency. Seeing that, for example, the intended raising of the leaving age and the progressive reduction of large classes depend upon the supply and training of teachers, the Board should take immediate steps, whatever the findings of the McNair Committee may turn out to be. The postponement of the reform of the dual system is held by experienced administrators to be quite unjustified by the facts. The omission of adult education from the first four-year plan is held to be unnecessary, seeing that much of it does not involve great outlay upon buildings and equipment. Finally, the case for forging straight ahead in the provision of nursery schools is, having regard to their social value both now and hereafter, quite unanswerable.

There are other problems arising out of the Paper which are not so urgent, but which are scarcely likely to be forgotten in parliamentary debates on the Bill. The reference to "public schools and other analogous schools" (paragraph 8) is one of them. In any discussion of the English public schools it is hard to disentangle reason and sentiment. However, two facts stand out clearly: (1) they have no counterparts in any other democratic country, and (2) though they are so few among so many, yet about three out of four of all the high offices of State and Church are filled by their products. Defenders of the public schools aver that if the schools produce leaders it is because of their intrinsic merits and nothing else. At this point the arguments begin to sway to and fro. If it be said that the basis of public school education is Christian, proof is demanded that the public school product is more markedly Christian than the county school product. If the defender of the public school says that it is independent of any other authority, he is asked whether standing aloof from the national system is really claimed as a merit. If he says that the headmaster has the power of what the Americans call 'hiring and firing', he is asked whether that is the kind of authority which should be vested in any one person. If he asserts that the child belongs to the parents and not to the State, and that parents have the right, by payment of fees, to choice and voice in their children's education, he is asked whether the parents who cannot pay fees thereby resign their rights to the State. And so the arguments succeed one another in a sort of ding-dong iteration. Probably the intelligent man-in-the-street, now that the full light of day is being cast on the situation, will find it hard to believe that the arguments produced are sufficient to explain the facts with which we started. Let us always remember, too, that most of the men and many of the women who will have to decide such issues are now scattered all over the world, and that post-war England may make short work of some of our hitherto accepted and uncriticized traditions.

Such are some of our second thoughts on the White Paper. The parliamentary discussion of its contents was interesting, appreciative and, on the whole, only mildly critical. When the Education Bill appears, the second thoughts of our legislators will resound through the land. It is to be hoped that both in its passage through Parliament, and in its subsequent translation into administrative action, it will fare better than its predecessors of 1870, 1902, and 1918.

MICE AND MEN

Voles, Mice and Lemmings

Problems in Population Dynamics. By Charles Elton. Pp. vii+496. (Oxford: Clarendon Press; London: Oxford University Press, 1942.) 30*s*. net.

In his preface, Dr. Elton tells us that: "The materials of this book have been assembled slowly for sixteen years. . . . The first part is a panorama of vole and mouse plagues in those countries for which records are available. The second part describes the vole and mouse fluctuations that occur in Great Britain and Scandinavia, and the methods developed at Oxford for the study of population dynamics in the field and laboratory. The third and fourth parts contain the history of similar fluctuations in Northern Labrador and Ungava that have an important influence upon the fur trade and the life of the natives." It may be said at once that the book is a great magazine of facts, a witness to the vast amount of useful work that has already been accomplished by Dr. Elton and his colleagues in the Bureau of Animal Population at Oxford, and it is enlivened by many a bright flash from the author. Nevertheless, it is not an easy book to review. The first two parts are excellent. But the reviewer feels, after reading them with great attention, that Parts 3 and 4 want pulling together; it would be worth while coaxing Dr. Elton later on, when he has forgotten the details and the archives of the Hudson's Bay Company and the Moravian missions, to write a little essay on this part of his subject.

Part 1, "Vole and Mouse Plagues", contains six chapters, of which the first, entitled "Ancient History and a Prophecy", is very fine. It opens with an account of Gérard's description of field-mouse plagues in Alsace during the six hundred years between 1271 and 1861 and directs attention to the immense literature of the subject. Dr. Elton says: "To comprehend the history of European mouse plagues one has to read, among other and less peculiar works, a fauna of Alsace by a French notary [Gérard]; a vole plague report by a learned Indian civil servant and oriental scholar [Elliott] who retired to become a landowner in Scotland; a folk-lore essay written by a classical scholar and head of an Oxford college [Powell]; a painstaking collection of classical references about animals by a school-teacher in Germany [Lenz]; and part of the works of Aristotle"—together with the Vulgate and English Bible cited by the author in his next paragraph. He says: "In spite of sweeping changes in God and circumstances, Authority has for several thousand years continued to act in much the same way, even to the present day. The Bible story is, if you like, a parable. The affair runs always along a similar course. Voles multiply. Destruction reigns. There is dismay, followed by outcry, and demands to Authority. Authority remembers its experts or appoints some; they ought to know. The experts advise a Cure. The Cure can be almost anything: golden mice, holy water from Mecca, a Government Commission, a culture of bacteria, poison, prayers denunciatory or tactful, a new god, a trap, a Pied Piper. The Cures have only one thing in common: with a little patience *they always work*. They have never been known entirely to fail. Likewise they have never been known to prevent the next outbreak. For the cycle of abundance and scarcity has a rhythm of its own, and the Cures are applied just when the plague of voles is going to abate through its own loss of momentum". In passing we may note that drastic cures sometimes prolong the ill; some years ago a group of tiny but valuable islands, in a Scottish loch, were devastated by water-voles, which resisted attack by keepers, dogs, traps and poison for many months. At last an expert, too lazy to need naming, was consulted; observing (to his relief) that the voles, for all their sleek appearance, were just living bags of pus, he fearlessly told the owner to close the islands and let the plague rip. The advice was taken and in a short time the voles disappeared, the grass grew again and the islands once more became good grazing.

In the remaining five chapters of Part 1 Dr. Elton reviews the history of vole and mouse plague in France, Germany, Holland, Italy, the Balkans, Russia, Palestine, Australia, the United States and Canada. He describes the efforts made by Pasteur, Loeffler, Danysz, and others to control the pests by bacteriological methods, and he gives a valuable account of Russian experience and research. He also develops the theme that the chief biological interest of "mouse-plague" centres in the periodicity of the fluctuations in the rodent population, and dealing with work done in the United States directs attention to the researches of Hamilton, who asserted that "it was possible to forecast high populations of mice 18 months before their appearance, while the mouse population was far from numerous. Following extensive warnings and suggested field practices 1½ years prior to the outbreak, orchardists were able to safeguard their trees in part from the most severe mouse infestation New York has ever experienced."

In Part 2 (pp. 126–233) Dr. Elton deals with the fluctuations in north-west Europe. He opens (Chapter 7) with a fine account of the Scottish vole-plagues of 1875–76 and 1891–92, which were remarkable not only for their severity but also for their location on the hills used for sheep-grazing. Sheep create conditions which are not favourable to undue increases in the vole population; whereas forest planting, for a time, favours the voles, grass growing luxuriantly in the plantations and affording abundant cover and food. We would remark in passing that voles, particularly species of Microtus, of which one was the species chiefly concerned in these plagues, are creatures of the open country and not of the forests; although they find convenient stations for recuperation at the edges of woods and in young plantations, sooner or later, when their numbers rise to a peak, they must swarm out into the open ground—sheep or no sheep. Winding up his account of these plagues and what was done to control them, Dr. Elton says: "In the impressive march of this outbreak we have seen a common but not extremely abundant inhabitant of the south Scottish hills increase suddenly within a year or two up to the absolute limit of subsistence, partially eliminating its chief competitor (the sheep), attracting to the area and maintaining for a short while a cloud of predatory birds, and giving also a feast for ground predators. Then its population subsides and leaves the predators in turn without subsistence. The grass recovers quickly and gives one of the best crops the shepherds have known."

In Chapters 8 and 9 an account is given of British research on the population dynamics of voles and mice between 1923 and 1939, that is of the work done by Dr. Elton and his associates in the Bureau of Animal Population at Oxford. Collett's account of the Norwegian lemming and its migrations and some of the fur returns of the Hudson's Bay Company cited by Gordon Hewitt were the sources from which Elton first gained the impression that rodent populations are subject to periodical fluctuations which occur quite independently of any variations (sometimes large) resulting from human interference. Later he found that this idea had been propounded, with characteristic insight, by Herbert Spencer in his "First Principles" so far back as 1863. It became the work of the Bureau to devise and to apply means and methods of testing this idea both in the study and in the field. The vast literature and the records of the Hudson's Bay Company and those of the Moravian missions were ransacked; field observations, including attempts to take at intervals a census of rodents and studies of their enemies in as many parts of the country as possible, were instituted on a large scale; and a long course of breeding and feeding experiments, together with a good deal of pathological and bacteriological research, was undertaken at Oxford.

In these ways much has been done already at the Bureau of Animal Population; but a great deal more remains to do. The problems involved have shown themselves to be subtle and of a far-reaching importance, which will tend to increase as the exploitation of 'backward' countries advances. Any detached philosopher, capable of taking one of those broad views in depth so cordially detested by statesmen and traders in all countries, will have little difficulty, after perusing this book and Lankester's "Kingdom of Man", in concluding that a world-wide biological service is one of the world's greatest needs, current disturbances notwithstanding. Such a service needs not only the co-operation of ecologists, systematists, and other scientific workers in all countries, but also public support. That can only be obtained from an educated public; and this education can best be given to the public by the museums, menageries and botanic gardens of the world. In all these institutions, to a degree varying with the character of each, attempts to bring the living world before the common man, to show the close interrelations of the fauna with the flora and of all their elements with one another, should be made by means of special exhibitions, lectures and publications. It is no longer enough to show the bare bones of systematics.

Meanwhile it is depressing to read of Dr. Elton's struggles to obtain financial support for the Bureau (p. 160). Participation in its work "usually involved a high personal risk to the continued livelihood of some or all of the members", leading naturally to undesirably frequent changes of personnel. "The search for money entailed a fantastic waste of energy and has slowly developed a skill in negotiations which can bear only an accidental relation to the real scientific value of a particular project." It is surely unworthy of a great country, with such vast interests in world agriculture, commerce, development, and the public health, to allow the Bureau to depend upon begging for its existence. So long as it does such work as is described in the present book, it will merit support from the State. The interest of the University of Oxford in the work of the Bureau is naturally more limited. Appeals to the world of commerce have been not unsuccessful; but commercial men are apt to have their own pet problems for solution and financial help from them too often deflects the man of science from his true goal.

Chapter 10 deals with Scandinavian lemmings and completes Part 2. Parts 3 and 4 are devoted to the periodical fluctuations in foxes, mice and lemmings, caribou and related creatures, including man, in Labrador and Ungava. Based largely on the records of the Hudson's Bay Company and the Moravian missions, they contain much hitherto unpublished material concerning Eskimos, Red Indians, and Whites in those countries as well as the great store of zoological information which is their chief purpose.

It remains only to note that the book is very well produced and illustrated with a frontispiece, showing an eighteenth century trapper, Captain George Cartwright, visiting his traps in Labrador, and with a number of clear maps and graphs.

M. A. C. HINTON.

LOGICAL EMPIRICISM

Between Physics and Philosophy

By Philipp Frank. Pp. v+238. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1941.) 15*s*. 6*d*. net.

THE title of this book is unfortunately chosen and is definitely at variance with the italicized statement on p. 103 that "*there are no boundaries between science and philosophy*". The suggestion of a sort of no-man's-land between physics and philosophy is indeed quite out of harmony with the ideas which Prof. Frank advocates. He was one of the original members of the "Vienna Circle" of logical positivists (or, as they have later been much better called, "logical empiricists"), and his book is particularly valuable for the authoritative account it gives of the origin and development of this school and its relations with cognate movements such as American pragmatism and the new logic of Russell and Wittgenstein. The book consists of reprinted addresses and articles extending over the period 1908–38, to which is prefixed a short historical introduction. It is clearly written, and should be read by all who are interested in the philosophical aspects of modern physics.

The main ideas of logical empiricism are now fairly well known in Great Britain, though it may be doubted whether their implications are widely understood. Perhaps the most concise statement of the most essential element of the system is given in the quotation from Carnap on p. 88: "There are no questions the answers to which are impossible for science in principle"—supplemented by the remark of Wittgenstein which follows: "When an answer cannot be expressed, neither can the question be expressed". Wittgenstein thus makes perfectly general what Carnap in this place restricts to science. Contrast with this the conjecture of Sir James Jeans that the "inner nature" of things (for example, of a centimetre) presents an essentially insoluble problem. Superficially it would seem as though Jeans had expressed an unanswerable question, but the logical empiricists would show (and here anyone who accepts the fundamental principles of science must acknowledge that they have proved their case) that he had merely written a succession of words without meaning. Obviously, to support their contention they must therefore pay special attention to the structure and function of language, and accordingly the more recent developments have been mainly in this direction. Carnap and Neurath in particular have directed investigations along these lines.

Without an appreciation of the way in which the logical empiricists have been forced to study language (and perhaps even with it) one can scarcely avoid the conclusion that they have allowed themselves to be diverted from the highway of progress in philosophy, along which they began to march, into a profitless *cul de sac*. Take, for example, the statement of the uncertainty principle (pp. 205–6). "Quantum physics says only that with certain experimental arrangements concepts like 'particle with a definite position' or 'particle with a definite velocity' can be defined. In other words, the physical processes which occur with these experimental arrangements can be predicted through statements in which one refers to 'a particle with a definite position' or 'a particle with a definite velocity', but there is no arrangement for which one can predict processes through statements involving 'a particle with a definite position *and* velocity'. This, however, does *not* mean that there are such particles, which, because of the defectiveness of our apparatus or because of malicious natural laws, we cannot measure in all their characteristics (position and velocity); it means rather that such combinations of words as 'a particle with coördinates x, y, z, and velocity v_x, v_y, v_z', must not be introduced into the language of physics". This is all very well, but why, in a free country, cannot we introduce such combinations of words if we wish? The answer in the end comes down simply to this, that we should then be led to expect experimental results (experiences) which do not occur. The language is therefore controlled by experience, and while it is, of course, essential that it should be so controlled, the insistence on a "physicalistic" as contrasted with a "phenomenalistic" language, in the interests of the unification of all science in a common language, seems to offer an easy passage to the control of experience by language.

The unification of science indeed comes perilously near to being enthroned as a dogma instead of being pursued as an ideal. It is the aim of every man of science to include more and more experience, of every kind, in a common logical system, but he is no true man of science if he does not recognize, first, that he may be aiming at the impossible, and secondly, that he is most likely to succeed in his object if he starts with different groups of experiences and correlates them by independent concepts, using independent languages, until by the growth of knowledge they may be united into a common system. Heat and mechanics began as independent studies, speaking independent languages, and later grew into the science of thermodynamics, for which the single language of energetics is sufficient. If the concepts and terms of the caloric theory had been denied to Carnot, what would have been the state of this science now ? Magnetism and electricity, radiant heat and light, chemistry and spectroscopy—examples are legion—all tell the same story ; and if, as we may hope, physics, biology and psychology are potentially one science, there would be little chance of their being recognized as such if the behaviourists, armed with the dogma of the logical empiricists' "physicalistic language", succeeded in depriving the infant science of psychology of all terms and concepts which physics at present does not need.

Prof. Frank devotes some attention to the social aspects of science, dealing in particular with the relation of logical empiricism to dialectical materialism. Here he is less convincing than in the more fundamental sections of the book. He introduces some special pleading in order to establish a likeness between the two systems of thought, and is accordingly forced to ignore the most essential elements of dialectical materialism. For example, he finds (p. 149) Lenin's doctrine that propositions such as "Matter is infinitely divisible" "are never to be labeled as true or false ; they are to be judged by their practical consequences" to be "very closely related" to the logical empiricists' view that "the truth of a proposition can only be judged if the methods of testing it are given". He omits to mention, however, that the "methods of testing" are utterly incompatible in the two cases, although two pages earlier he has stated that dialectical materialism "understands by test, above all, the test of a principle in social life, in revolutionary practice, as they put it". Does logical empiricism find the meaning of infinite divisibility in revolutionary practice ? Again, on p. 125 it is stated that a recent tendency to find support in modern physics for philosophical idealism has "no connection with any 'crises in physics' or with any 'new physical conception of nature'. It is rather associated with a crisis in human society arising from quite different processes". This is a remarkable statement from one who holds that the truth of a proposition can only be judged if the methods of testing it are given. By what test has Prof. Frank found a connexion between Jeans's 'mathematical God', which is particularly mentioned, and a "crisis in human society" ? And how has he established that the conception of that God has no connexion, not even an illogical one, with the quantum theory ? It is to be feared that here Prof. Frank is neither logical nor empirical ; he has used combinations of words which must not be introduced into the physicalistic language.

This, however, is a minor aspect of a book which, in the main, may be received with praise and gratitude. It is characteristic of the logical empiricists that (except in the later developments of their language analysis, which reveal everything about language except that it is intended to mean something) they express themselves clearly, unambiguously and, for the most part, convincingly. Prof. Frank has retained these qualities for thirty-five years. Let us hope that he will continue to interpret the development of one of the most significant of modern schools of philosophy.

HERBERT DINGLE.

SCIENCE AND INDUSTRY OF PLASTICS

Synthetic Resins and Allied Plastics

By Various Authors. Edited by Dr. R. S. Morrell. Second edition. Pp. xiii+580. (London: Oxford University Press, 1943.) 35*s*. net.

THE second edition of "Synthetic Resins and Allied Plastics", edited by R. S. Morrell, reflects the spectacular advances made in this field of applied chemistry, inasmuch as ten experts have been called on to collaborate in the production of the present volume. It is only five years ago since the first edition, compiled by four authors, made its appearance, endeavouring in one volume to cover the whole of the plastics industry from both technical and theoretical points of view. The present edition is structurally similar to the first edition, but considerably expanded to cover the progress made during the past five years. Each chapter is a condensed review of individual fields of plastics.

For the ordinary reader the introductory chapter is almost, in itself, a sufficient review of the industry and science of plastics, but the succeeding chapters on resins derived from proteins, cellulose, phenols, and urea in combination with formaldehyde, on the vinyl, acrylic and coumarone polymers, the ester gums, and finally on the alkyd and petroleum hydrocarbon resins, are exhaustive in their detail, and possibly only those intimately connected with this branch of applied science can thoroughly appreciate the vast strides made in recent years.

There are also special sections on the application of phenol and urea-formaldehyde resins as components of varnishes and enamels, and a very interesting chapter on miscellaneous resins wherein are described many plastics which command attention either on account of their mode of formation or because of their specialized application, but which have not yet been sufficiently developed to justify classification into groups. Included in this edition also are chapters on electrical tests carried out on resins and on methods of identification of resins. This latter, together with two sections on the theory of resinification, will give much food for thought and should be productive of new ideas and methods of approach in the elucidation of this problem. Finally, there are many illustrations, and each chapter is amply supported by a very comprehensive list of references to original publications.

This brief summary of the contents of the work will serve to show the wide field of readers to whom this valuable book should appeal. Not only the technician but also the more secluded research worker will find a very full account of the progress of the science of plastics, and also much theoretical information. Undoubtedly this edition will be eagerly sought after by all those interested in the science or engaged in the manufacture of modern plastics.

The Technique of Radio Design

By Dr. E. E. Zepler. Pp. xii+311. (London: Chapman and Hall, Ltd., 1943.) 21*s*. net.

The author of this book has had a number of years experience as a radio designer in the research and development departments of two well-known commercial firms, one in Great Britain and one in Germany; and the book records much of that experience as an aid to the radio equipment engineer in dealing with his daily routine problems.

The scope of the work covers the design and basic construction of radio communication receivers of all types, and concerns intimate details of receiver work rather than a comprehensive treatment of principles, which are already adequately catered for in other publications. The first chapter, on "Some Fundamental Theoretical Facts", is preceded by a list of symbols and some useful formulæ and graphs on the inductance, capacitance and impedance of wires, coils and feeders. The succeeding chapters then deal in a very practical manner with the transfer of the received signal from the aerial to the first amplifying stage, and so on to the detection and frequency-changing portions of the receiver. The problems arising from the requirements of selectivity, gain and frequency control and the necessity of suppressing or limiting receiver noise, hum and spurious beats are described; and it is gratifying to find a whole and very practical chapter devoted to the important subject of screening in the various ways in which it is relevant to the design of a good radio receiver. Later chapters deal with power supply, routine measurements and fault finding.

The book is to be recommended as a good combination of theory and practice, and should be at the disposal of all engineers and physicists concerned with the design of radio-receiving equipment, whether of an experimental or commercial type.

Food and Farming in Post-War Europe

By P. Lamartine Yates and D. Warriner. (The World To-day Series.) Pp. 118. (London, New York and Toronto: Oxford University Press, 1943.) 3*s*. 6*d*. net.

The reconstruction of European agriculture will be one of the most urgent and complex tasks confronting the United Nations on the conclusion of hostilities. It is not reconstruction so much as revolution that is required to dispel the grinding, hopeless poverty of the vast mass of peasantry that has been a chronic cause of economic and political unrest, particularly in south-eastern Europe. For the sake of brevity the authors of this book have simplified the presentation of the problem without, however, sacrificing clarity. There are far too many farmers in Europe, they produce the wrong kinds of foodstuffs, they are ill-fed, and they are unorganized economically. The basis of re-organization must be increased industrialization to relieve rural over-population, the substitution of intensive mixed farming for predominantly grain farming, and great improvements in technical efficiency and marketing. The rural and urban populations would be economically complementary, each providing a steady market for the produce of the other. The economic, social and political obstacles to the realization of such a plan are immense, and the authors confront them boldly. They are, however, confident that they can be overcome, and their arguments, supported by well-marshalled facts, lend support to their confidence.

Land, Air and Ocean

By R. P. Beckinsale. Pp. 407+18 plates. (London: Gerald Duckworth and Co., Ltd., 1943.) 15*s*. net.

To compress into a single small volume an account of all aspects of the physical basis of geography is an ambitious task, but on the whole the author has been successful. It may be questioned whether the book is full enough for university work, but it certainly touches on nearly all problems that have to be considered and gives, on each chapter, useful and modern references for further study. There are even indications of the human bearing of the physical considerations. Naturally some parts are fuller than others. The chapters on the atmosphere are perhaps the best and include mention of much recent work. Some revision and amplification would not be out of place in the account of ocean waters and submarine relief, and in the paragraphs on icefields. On many subjects it is difficult to compile a short but comprehensive list of further reading, but a few additions would not be out of place in the chapters mentioned. There are several well-chosen diagrams and photographs. The book, though condensed, is most readable.

Tables of Legendre Associated Functions

By Zaki Mursi. (Fouad I University: Faculty of Science, Publication No. 4.) Pp. viii+286. (Cairo: Fouad I University, 1941.)

Until recently the only tables of the associated Legendre functions $P_n^m(x)$ were those of Tallqwist (Helsingfors, 1906), who calculated them for values of n and m up to 8 and for values of x from 0·00 to 1·00. As the function vanishes when the positive integer n is less than the positive integer m, Tallqwist's tables contained 3,600 entries. He calculated functions of even order exactly, and those of odd order with an accuracy varying from four to ten decimal places. Now the Fouad I University at Cairo has provided a much more extensive table, for values of n and m up to 10, and for values of x from 0·000 to 1·000. The entries have been obtained correct to 8 decimal places, except for $n = 9$, 10 and m equal to or greater than 5, where, as the entries are large, the values have been calculated to four decimal places only. Parts of the tables have been checked by Dr. L. J. Comrie, whose knowledge and experience of mathematical tables are exceptionally wide.

The Biological Control of Insects

By Hugh Nicol. (Pelican Books, A.113.) Pp. 174+8 plates. (Harmondsworth and New York: Penguin Books, Ltd., 1943.) 9*d*. net.

The control of insect pests by means of parasites and predators appeals to the biologist and the general public alike. The biologist sees in the method the practical application of scientific knowledge by the utilization of living organisms. To the public it forms an attractive chapter in the progress of applied science. Dr. Nicol has recounted the history and practice of the methods of biological control in an attractively written volume. His account is accurate, free from undue technicality and shows an unbiased detached viewpoint. It can be recommended to a wide circle of readers including scientific folk themselves. As the author remarks, there is science, and also material for philosophy, for the reader who looks a little beneath the surface of the story, here recounted, towards the deeper issues.

PRINCIPLES OF INSECTICIDAL BIO-ASSAY

By DR. H. HURST

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THE need for standardized methods of testing insecticides has become an important factor in insecticidal research, especially where routine examination of new materials is desirable. Chemical assay may provide an index of the potential toxicity of an insecticide, but evidence has been provided recently to show that the influence of toxicant concentration in an insecticide may be completely obscured by variation in the physico-chemical properties of the carrier medium[1]. The fact that each component of an insecticide may contribute towards gross toxicity restricts the usefulness of chemical assay as an index of toxicity. Hitherto, attempts which have been made to correlate chemical and biological tests have been based on the invalid assumption that the main purpose of a carrier medium is to transmit the insecticide to the test insects, after which toxicant concentration is a limiting factor in biological activity. This assumption has provided a general basis for 'standard' methods of insecticidal bio-assay, in which attention has been directed more towards arbitrary elimination of unknown variable factors than towards the fundamental causes of this variation[2].

In the present article an attempt is made to analyse some of the main factors which influence dosage-biological activity relations in systems in which insecticides are brought into contact with insects under controlled conditions.

The fundamental variables in an insecticidal test system may be resolved into (1) the test insect, (2) the insecticide, and (3) the mode of application of the insecticide to the test insect.

The choice of test insect is of prime importance in the design of the particular test system, for when the insecticide and mode of application remain constant, insecticidal evaluation depends on the sensitivity and specific susceptibility of the test insect.

An insecticide generally consists of a toxic principle or toxicant which is dissolved or otherwise dispersed in a carrier medium, which may be a homogeneous liquid or a heterogeneous system of mixed components. The potency of the insecticide is then evaluated from dosage-biological activity relations, where 'dosage' refers to the application of a standard quantity of insecticide, and 'biological activity' is measured by some selected specific response shown by the test insect.

The biological activity of an insecticide may vary greatly according to the mode of application used. In practice, liquid insecticides are usually applied as an atomized spray, which may be used in the control of flying insects, or deposited as a 'film' on various surfaces for secondary transmission to insects which come into contact with these surfaces.

These considerations may be illustrated by some selected examples in which insecticides are applied to insects in systems which represent the limits of a range of conditions under which insecticides are generally used in practice.

System 1

Components.—Test insect; pure toxicant.

Mode of Application.—Complete immersion of test insect in pure toxicant.

The simplest method of external insecticide application consists in immersing the test insect in relatively large proportions of pure drug. Since the external drug phase is large in relation to the biological test system, the disturbing influences of drug depletion in the external phase and drug distribution between the carrier medium (which is normally present in insecticidal mixtures) are avoided. In practice, this type of system is rarely used, for it is important to measure insecticidal action over as wide a range of toxicant concentrations as possible. Moreover, very few insects will resist immersion in pure toxicant for a sufficient period of time to ensure accurate experimental observation of specific biological responses. Nevertheless, systems of this type are very useful for measuring the relative molecular reactivities of members of homologous series of drugs, since distribution between an external carrier phase and the biological system is not a limiting factor in drug access. Mature blowfly larvæ (*Calliphora erythrocephala*, *Phormia terrænovæ*, *Sarcophaga falculata*) are suitable test insects which are extremely resistant to high toxicant concentrations present as an external insecticidal phase.

Even in simple systems of this type, complex factors are involved in the production of specific biological responses such as paralysis, or death. For example, a drug may 'induce' its own penetration or access through the cuticle by interacting with the lipo-protein components of the cuticle framework. In other words, the resistance of an insect to an insecticide depends on 'functional cuticle permeability', which is determined by the nature of the drug-cuticle association in the particular test system[1].

It has generally been assumed that drug specificity depends mainly on the molecular interaction of the drug with the ultimate cell receptors at the site of action in the biological system. But where the drug has first to penetrate through an intermediary biophase which links the site of drug application with the site of drug interaction, the effects of molecular specificity may be completely obscured by diffusion processes involved in drug access. In fact, with insects such as blowfly larvæ, the relative toxicities of drugs such as normal primary alcohols and fatty acids measured by iso-active external concentrations differ markedly from relative drug reactivities based on iso-active internal concentrations in the hæmolymph.

The importance of this fundamental conclusion lies in the implication that where differences in permeability exist between the cuticles of a range of test insects, the relative biological activities of a range of drugs or insecticidal mixtures measured with one particular species of test insect will not necessarily be similar to corresponding 'evaluations' with other species of test insects. This factor is a difficulty which stresses the need for caution in the correlation of the results of insecticidal bio-assay in different test systems, and shows that physiological factors must also be considered in assessing the toxicity of insecticides.

System 2

Components.—Test insect; toxicant; carrier.

Mode of Application.—Complete immersion in insecticidal mixture.

Systems of this type may be classified broadly into three main categories in which biological activity depends on certain limiting factors.

A. Carrier non-toxic; toxicant non-toxic. Carrier

+ *toxicant non-toxic.* Mature larvæ of the blowfly *Sarcophaga falculata* will remain active for more than an hour when immersed in kerosene or ethyl alcohol; mixtures of ethyl alcohol and kerosene are also relatively non-toxic. The limiting factor is the impermeability of the insect cuticle; variation in the relative proportions of carrier and toxicant produces no significant change in biological response.

B. Carrier non-toxic; toxicant non-toxic. Carrier + toxicant toxic. (1) When immersed in pure kerosene or ethyl alcohol, mature *Calliphora erythrocephala* larvæ behave similarly to Sarcophaga larvæ, and show no symptoms of paralysis even after an hour. Mixtures of ethyl alcohol and kerosene are extremely toxic, and the insects are rapidly immobilized—within a few seconds. The functional permeability of the cuticle is so high in the presence of kerosene that rapid access of the ethyl alcohol to the internal body fluids of the insect results in an increase in volume of about 50 per cent within three minutes. This stage is followed by the bursting of the insect when the internal pressures become excessive. These effects are produced with great rapidity by mixtures containing 20–80 per cent alcohol. On either side of this range equitoxic effects may be produced, showing that *toxicant concentration* is not necessarily a limiting factor in biological activity when an external insecticidal mixture is brought into contact with an insect. Where the concentration of alcohol is low, toxicity will increase with increase in alcohol concentration, since within this range toxicant concentration is a limiting factor in drug access. But where the concentration of ethyl alcohol is high, toxicity will decrease with increase in toxicant concentration, since within this range functional cuticle permeability decreases with decrease in carrier activity.

(2) A similar example of more practical importance is shown by the influence of 'carrier activity' on the biological activity of pyrethrins, which show a higher degree of insecticidal activity than any other known natural or synthetic insecticide. Primary symptoms of pyrethrin intoxication are produced very slowly when mature Sarcophaga larvæ are immersed in a concentrated pyrethrum extract containing 30 per cent pyrethrins*, and the insects become immobilized within 20–30 minutes. In this system the carrier for pyrethrins consists of a mixture of fatty acids, resins, and other impurities derived from the original pyrethrum extract, and carrier activity is low. Dilutions of this concentrated extract with a heavy oil of the medicinal paraffin type show no marked change in biological activity until low toxicant concentrations are reached, when further dilution with heavy oil produces a decrease in biological activity.

(3) If the original concentrate is diluted with a lower boiling paraffin fraction of the kerosene range, carrier activity becomes very apparent at very low concentrations of kerosene (2–5 per cent), and as dilution proceeds there is a progressive increase in biological activity of the drug mixture. This is due to the rapid increase in functional cuticle permeability which is induced by the association of the kerosene with the cuticle framework[1]. Carrier activity is inversely proportional to carrier viscosity, and in this system functional cuticle permeability is so high that complete paralysis is produced within 1–2 minutes by solutions containing pyrethrin concentration so low as 0·005 per cent. Evaluation of toxicant activity is only practicable within a very restricted range owing to the rapidity of paralysis inception.

Systems (2) and (3) represent the outer limits of a range of test systems in which toxicant activity may be used as an index of carrier activity, since the rate of drug access is determined mainly by the functional cuticle permeability.

C. Carrier toxic; toxicant toxic. Carrier + toxicant toxic. Tenebrio molitor larvæ are immobilized within 1–2 minutes by immersion in kerosene, ethyl alcohol, or mixtures of these components. Owing to the relative susceptibility of the test insects under the particular mode of application of the insecticide, toxicant and carrier activities are masked by carrier toxicity. In systems *A* and *B*, carrier toxicity is small. Many flying and crawling insects (for example, adult Diptera, larval and adult stages of Coleoptera, Lepidoptera, nymphal and adult stages of Orthoptera, Hemiptera) are susceptible to carriers such as kerosene, and such test insects are unsuitable for test systems in which the external insecticidal phase is relatively large in relation to the test insect.

From these examples it is clear that, in a particular test system, the biological activity of an insecticide depends not only on the nature and concentration of the toxicant, but also on all other components of the insecticidal mixture, irrespective of the toxicity of these components, and that bio-assay gives a measure of a gross summation of effects which may be analysed by the appropriate choice of biological component. In systems where carrier toxicity is not a limiting factor in bio-assay (*B*, (1), (2), (3)), relatively enormous changes in biological activity of an insecticidal mixture containing a fixed proportion of toxicant may be produced simply by variation of the carrier components. The importance of physiological factors is shown by the contributory influence of carrier toxicity on the biological activity of an insecticidal mixture. Where the external insecticide phase is relatively large, carrier toxicity may completely swamp bio-assay of toxicant activity (*C*). Where low cuticle permeability is a limiting factor in drug access, bio-assay of toxicant activity is also impracticable (*A*).

System 3

Components.—Test insect; toxicant; carrier.

Mode of Application.—Insecticide applied to test insect by secondary transmission from residual 'film' primarily deposited on absorbent substrate.

The difficulties inherent in methods of assay where the carrier itself is toxic may be surmounted by the introduction of an additional limiting factor into systems of the above type. For example, the poison mixture may be first deposited on a porous substrate where a proportion of the mixture becomes immobilized by absorption or adsorption processes. The deposit of poison mixture in the porous surface may be adjusted to form a thin film on the surface of the framework. 'Film activity' may be measured by introducing suitable test insects on to impregnated substrates which comprise a range of deposit volumes and toxicant concentrations. The biological responses produced depend on (1) toxicant concentration and (2) film thickness, which influences the transmission of insecticide to the test insects, and also 'sensitizes' the insects to the action of the toxicant. Where the insects are susceptible to carrier toxicity, excessive film thickness produced by substrate satur tion deposits results in a system which approximates to system 2 *C*, and toxicant bio-assay is impracticable.

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* The author is indebted to Dr. T. F. West (Messrs. Stafford Allen and Sons, Ltd., London) for preparing the pyrethrum extracts used in these experiments, and also for valuable technical advice.

By the selection of an appropriate range of film thicknesses, the disturbing influence of individual biological variation on the susceptibility of the test insects may be largely eliminated by superimposing on this individual variation a predetermined wider range in 'functional susceptibility'. Where film thickness is small, insect functional susceptibility is low, and toxicant bio-assay is possible at high initial toxicant concentrations. Similarly, with increase in film thickness, there is a decrease in the threshold active toxicant concentration in the bulk phase of the insecticidal film. In this way bio-assay of insecticidal activity may be carried out over a relatively wide range in toxicant concentrations. The sensitivity of this method is illustrated in the accompanying table by some typical data for the insecticidal film activity of pyrethrum – kerosene sprays to *Calandra granaria* weevils.

Analysis of results. In practice the biological activity of an insecticide represents a summation of the effects of toxicant activity, carrier activity, and carrier toxicity. Hence a representative index of biological activity is obtained by summation or average of the biological responses produced by a given initial toxicant concentration applied at dosages *A*, *B*, *C*, *D*, which comprise a comprehensive range of carrier activities and carrier toxicities.

Pyrethrum content of spray (% wt./vol.)	% Paralysis (3 hr.).					*I.C.T.* coefficient	% Paralysis (24 hr.)					*I.C.T.* coefficient
	A	*B*	*C*	*D*	Average		*A*	*B*	*C*	*D*	Average	
0·10	42	72	97	92	76	1·33	100	97	100	100	99	1·13
0·09	50	65	92	90	74	1·30	97	100	100	100	99	1·13
0·08	47	62	92	92	73	1·28	97	100	100	100	99	1·13
0·07	45	57	90	87	70	1·23	97	95	100	100	98	1·11
0·06	30	50	82	90	63	1·11	95	97	97	100	97	1·10
0·05	17	60	70	80	57	1·00	75	80	97	100	88	1·00
0·04	17	55	62	62	49	0·86	47	80	97	100	81	0·92
0·03	15	32	40	47	33	0·58	50	62	87	90	72	0·82
0·02	7	22	27	45	25	0·44	25	45	82	87	60	0·68
0·01	0	0	7	25	8	0·14	2	2	37	75	29	0·33

Substrate: Whatman No. 1 Filter paper, 7 cm. diameter.
Dosage Deposits: *A*, 0·1 c.c. (0·0026 c.c./sq. cm.)
B, 0·12 c.c. (0·0031 c.c./sq. cm.)
C, 0·14 c.c. (0·0036 c.c./sq. cm.)
D, 0·16 c.c. (0·0042 c.c./sq. cm.)
Initial age of films, 20 min.
40 Calandra weevils per filter paper (exposed in open petri dishes, 25° C.; relative humidity, 70 per cent).

In the above system carrier toxicity becomes a limiting factor at substrate saturation deposits of approximately 0·3 c.c. per filter paper. The system approximates to system 2 *C*, and rapid immobilization of the test insects precludes bio-assay of toxicant activity. Dilution (0·05 per cent pyrethrins) may be conveniently used as a standard for comparison with a range of kerosene dilutions of pyrethrum-kerosene sprays of unknown pyrethrin content. Bio-assay is based on the ratio of average percentage paralysis per deposit range *A*–*D* to that of the standard. This ratio gives a coefficient, which may be expressed generally as the *I.C.T. Coefficient* (*I*, test insect; *C*, carrier; *T*, toxicant). In this way particular test systems may be specifically defined. For example, from the data summarized in the accompanying table the *I.C.T.* (*Calandra—kerosene—pyrethrins*) coefficients of film activity (3 hr.) of insecticides containing 0·06, 0·05 and 0·04 per cent pyrethrins, are 1·11, 1·00 and 0·86 respectively; corresponding values at twenty-four hours exposure are 1·10, 1·00 and 0·92 respectively. For this range, bio-assay of toxicant concentration is possible within wide limits of dosage exposures (3–24 hours); at higher toxicant concentration (0·06–0·10 per cent pyrethrins), bio-assay is obscured by excessive toxicant activity.

The insecticides are deposited uniformly on the filter papers by means of a graduated micro-pipette (total capacity 0·2 c.c.). With low-viscosity oils such as kerosene, diffusion equilibrium in the system insecticide – substrate is rapidly attained, and uniform sampling of the insecticidal film is brought about by the activity of the test insects. In practice, the number of standards used may be restricted to the range 0·04–0·06 per cent pyrethrins. The unknown insecticide is then diluted with standard kerosene spray base to give a range of insecticides which are approximately iso-active with those within the range of standards. The pyrethrin content of the unknown may then be assessed from the dilution factor. By the appropriate choice of standards and dosage deposits a wide range of pyrethrin contents may be assayed.

Bio-assay of pyrethrum heavy-oil preparations. The carrier activity of a heavy oil of the medicinal paraffin type (for example, Shell oil *P*.31) is small in relation to that of a carrier medium such as kerosene, and higher pyrethrin concentrations are necessary to produce comparable biological responses within a given period of exposure. A range of standards containing 2–0·2 per cent pyrethrins may be used for preliminary 'sorting out' tests. Sensitivity within this range is greatest in the region of 1 per cent pyrethrins. For example, the *I.C.T.* (*Calandra* – *P*.31 – *pyrethrins*) coefficients of solutions containing 1·2, 1·0 and 0·8 per cent pyrethrins are respectively 1·14, 1·00 and 0·59 (3 hr.); 1·09, 1·00, 0·76 (24 hr.).

Scope of Method. Measurement of *I.C.T.* coefficients at intervals gives an index of the nature of the intermediary chain of biological responses which culminates in eventual mortality. This is of importance where secondary toxicants or 'activators' may be present. In the system pyrethrins – kerosene – sesame oil, the kerosene is a *primary* activator for pyrethrins in so far as 'knock-down action' or paralysis is determined by the increase in functional susceptibility of the test insects which is induced by the kerosene. Sesame oil is a *secondary* activator which does not increase 'knock-down action' (high sesame oil contents of 30–50 per cent *decrease* the knock-down activity of pyrethrum-kerosene sprays by inducing a selective decrease in functional cuticle permeability), but results in combined action with pyrethrins at a later stage when the recovery phase of pyrethrin poisoning normally occurs. The efficiency of a secondary activator for pyrethrins, such as sesame oil or *iso*butylundecylenamide, may be assessed from the minimum concentration of activator which eliminates the recovery phase of standard pyrethrum-kerosene solutions by the inception of secondary *irreversible* toxic action during this phase. Bio-assay of an insecticidal spray containing a secondary activator should be based on analysis of biological activity at various stages after spray application to the test insects. For example, under practical conditions, the 'knock-down' efficiency of a pyrethrin-oil spray for flying insects is influenced primarily by pyrethrin content and carrier activity of the oil medium; the secondary effect of activators such as sesame oil becomes apparent after this initial 'knock-down action'.

This method of assay, which involves the use of a range of dilutions of toxicant, has many features in common with the Rideal-Walker (R-W) test for the evaluation of the killing efficiency of disinfectants[3]. Here the weakest concentration of disinfectant killing standard bacterial cultures in a definite time period is divided by the weakest concentration of phenol killing in the same period; the ratio is the phenol coefficient. With a range of dilutions to cover threshold toxic concentrations, greater sensitivity is obtained than is possible using a reference standard at a single fixed concentration.

System 4

Components. Test insect (flying); toxicant; carrier in closed chamber.

Mode of Application. Insecticide introduced into chamber as atomized spray.

In Systems 1 and 2, where the external insecticidal phase is large in relation to the biological component, the capacity of the insecticide/cuticle interface for transmission of insecticide to the insect is at a maximum, and toxicant dosage is mainly determined by functional cuticle permeability and by the period of immersion in the insecticidal mixture, since carrier toxicity is not a limiting factor in bio-assay. In System 3, carrier toxicity may be eliminated as a dominant factor in biological activity by a controlled mode of application of insecticide in which the bulk of the insecticide is primarily immobilized in a porous substrate so that secondary transmission to the insect is determined by the *local* capacity for transmission of insecticide at the insecticidal film/cuticle interface. In Systems 1, 2 and 3 the relations of the insecticidal components and test insects are such that uniformity in the mode of application of insecticide to the test insects may be controlled so as to assess the relative influence on gross biological activity of toxicant activity, primary carrier activity, carrier toxicity, and secondary adjuvant or activator activity.

Where the test insects are flying insects enclosed in a spray chamber, and the insecticide is introduced as an atomized spray, individual insect dosage is largely dependent on the insect distribution and spray distribution relations. A system of this type is used in the Peet-Grady method, which is the official method of the National Association of Insecticide and Disinfectant Manufacturers for evaluating liquid insecticides[4]. Uniformity of experimental conditions is obtained by arbitrary standardization of unknown variables. The test procedure involves the use of a standard fly-rearing room, testing room, test chamber, fly cages, atomizer, and insecticide paper which is used to line the floor of the test chamber in which the flies are sprayed.

The dosage-biological activity relations in this method of test are extremely complex. For example, reduction of exposure time of 10–5 min. has been shown to have little influence on the knock-down and kill when a standard 12 ml. dosage is used[5]. An extension of these experiments by the present author has shown that an increase in exposure period from 5 to 120 minutes results in only a slight increase in toxicity. The kills obtained at exposure periods of 5, 10, 15, 20, 30, 60 and 120 minutes were 35, 36, 32, 34, 36, 43 and 49 per cent respectively*. It is interesting to note that despite a large variation in exposure period the relative biological activities of standard dosages sprayed into the chamber remain relatively constant. This indicates that toxicity is mainly determined by the initial dosage transmitted to the flying insects during and shortly after spraying, although with kerosene-type sprays a residual 'mist' of finely atomized spray droplets may persist for about twenty minutes. The reproducibility of the results obtained under these conditions cannot be attributed to uniformity in individual fly dosage. A threefold variation in average fly dosage has been demonstrated by a careful colorimetric analysis of the individual dosages received by flies sprayed with insecticides containing suitable dyes under standard Peet-Grady test conditions[6]. This evidence suggests that fly distribution is a dominant factor in individual fly dosage – biological activity relations, since the gross variation in individual fly dosage can scarcely be ascribed to lack of replication in the gross characteristics of spray distribution. The disturbing influence of spray distribution is shown by the fact that the relative toxicity of pyrethrum-oil insecticides may be completely reversed by variation in the sprayer used. Moreover, the present author has found that at spraying pressures of 2, 12·5 (normal), and 25 lb./sq. in., the kills produced by standard 12 c.c. dosage of *O.T.I.* (Official Test Insecticide, approximately equivalent to 0·1 per cent *W/V* pyrethrins in a kerosene spray base) were 15, 36 and 45 per cent respectively, showing that toxicity increases with spraying pressure*.

From this evidence the general conclusion may be drawn that in systems in which an insecticide is applied as a spray to flying insects confined within a closed chamber, uniformity of individual insect dosage is limited by dominant factors of fly distribution and spray distribution, which are characteristic of particular systems.

This fundamental conclusion has provided a basis for the investigation of the general dosage – biological activity relations in systems of this type. A detailed account of the numerous variable factors involved is beyond the scope of the present article, and will be given elsewhere, but the following brief summary will serve to illustrate the complexity of the factors which contribute towards gross toxicity.

(1) For a given test chamber and sprayer, bio-assay of toxicant activity may be completely obscured by variation in carrier activity. A standard dosage of a solution of 0·1 per cent pyrethrins in a heavy oil carrier (Shell oil *P*.31) produces only a slight knock-down action (30–50 per cent) during the standard exposure of ten minutes in a Peet-Grady chamber, and cannot be evaluated by comparison with a similar standard consisting of a 0·1 per cent solution of pyrethrins in kerosene where carrier activity is high[1].

(2) Where the toxicant has a relatively high vapour pressure (for example, organic thiocyanites

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* The author is indebted to the Shell Refining and Marketing Company, Technical Prods. Dept., London, for the use of a Standard Peet-Grady Chamber in which these tests were carried out.

such as 'lethane' or 'thanite'), toxicity depends on (1) contact activity of the toxicant carrier liquid phase, and (2) fumigant activity of the toxicant phase; (2) is relatively independent of (1).

Some rather 'aberrant' results may be obtained when spray chambers are used for the evaluation of insecticides in which different toxicants and carriers are present. For example, the toxicity of an insecticide consisting of a solution of pyrethrins in heavy oil *increases* on dilution with a kerosene spray base owing to an increase in carrier activity (*cf.* systems 2*B*, 2, 3). On the other hand, variation in carrier activity produces only a slight variation in toxicity of sprays containing lethane or thanite, since fumigant toxicant activity is an important factor in gross toxicity. In other words, for given initial toxicant concentrations the relative toxicities of pyrethrum–oil, lethane–oil, and thanite–oil sprays may vary within wide limits simply by appropriate 'adjustment' of carrier activity. Two per cent thanite–oil sprays which show a higher official Peet-Grady rating than *O.T.I.* show a considerably lower rating when tested by the *I.C.T.* coefficient rating (System 3), since fumigant activity is no longer a limiting factor in bio-assay.

(3) With decrease in chamber size, the disturbing influences of fly distribution and spray distribution factors on individual fly dosage diminishes, since it is possible to attain more uniform and higher initial spray concentrations than is practicable with larger chambers of the Peet-Grady type. This is shown by the relatively high initial rates of knock-down produced in the smaller chambers, especially where the toxicants used exert fumigant activity. Similar results have been obtained independently by other investigators[7].

(4) Where the spray storage capacity of the floor of the spray chamber is small, secondary transmission of insecticide from the floor of the chamber to the test insects may be an important factor in gross dosage-mortality relations, since the bulk of the spray is eventually deposited on the floor (*cf.* System 3). The adhesion of finely atomized oil spray droplets to vertical surfaces in the chamber is relatively small. Where the floor of the chamber is lined with an absorbent surface or substrate of high spray storage capacity, film activity is slight and toxicity is mainly influenced by initial spray administration and residual 'mist action'.

It is clear that the physico-chemical factors which influence the dosage–biological activity relations in fly spray chamber methods of insecticidal bio-assay are extremely complex and only become apparent after comparison with much simpler systems of the types 1, 2 and 3. Careful arbitrary standardization of unknown variable factors in the Peet-Grady method is of doubtful significance where variation in carrier activity may obscure variation in toxicant activity. In fact, the use of a standard reference insecticide such as *O.T.I.* as a basis for the evaluation of pyrethrin content in samples of unknown composition is only valid for a restricted range of insecticides in which carrier activity is of a similar order to that in the standard. Where the unknown samples contain toxicants other than pyrethrins, bio-assay provides an index of a gross summation of effects which are characteristic of the particular test chamber and do not necessarily hold in other chambers or under practical conditions of test where, for example, fumigant activity is negligible. Caution is also necessary in the correlation of the biological activity of a spray with some relatively simple factor such as particle size distribution, for kinetic factors are also involved in the transmission of the spray droplets to the insects. High viscosity oils, even when finely atomized, are ineffective under practical conditions owing to dispersion factors, and droplets of less than 17 microns seldom strike the object towards which they are sprayed[8].

It is hoped that the principles which have been illustrated in the present article may serve as a guide to other investigators in the field of insecticidal research, especially those who are primarily concerned with the bio-assay of insecticidal preparations of unknown composition and physico-chemical properties. It is only from the scientific analysis of the limiting factors which influence the biological activity of an insecticide in a selected range of controlled test conditions that the ultimate efficiency of the insecticide under more variable field conditions may be assessed with any degree of accuracy.

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THE BIOLOGICAL SECTION OF THE UKRAINIAN ACADEMY OF SCIENCES

By NIKOLAI GRISHKO

AT the present time the Ukrainian biologists are working in the sister republic of Bashkiria, where the Ukrainian Academy of Sciences was evacuated from its home in Kiev.

The Institutes of the Academy are continuing their valuable research work on the development of theoretical subjects in various branches of biology, and at the same time have included in their programmes of work a number of practical problems connected with war surgery, therapy and general war medicine, and problems connected with the maximum utilization of the natural resources of the country and the increase in the output of agricultural products.

Several of the Institutes' laboratories are working on problems connected with the more rapid healing of wounds, the knitting of fractured bones, problems connected with relieving the sufferings of the wounded and ensuring their more rapid return to the ranks.

Prof. A. Bogomolets, director of the Institute of Clinical Physiology, has proved that the employment of the anti-reticular cytotoxic serum is very effective in speeding up the processes of healing flesh and knitting broken bones.

This new treatment is already widely used in the hospitals and clinics of the Soviet Union. It is one of the results of many years research by Prof. Bogomolets and his pupils into the part played by connecting tissues in the organism, research work which is being successfully continued to-day.

Prof. Nina Medvedova, one of Prof. Bogomolets' colleagues, has discovered new functions of the cortex of the suprarenal glands—functions which regulate carbohydrate metabolism. She has succeeded in producing, in the form of an extract, the hormone of the cortex of these glands, which she has named 'corticalin'. Corticalin is a hormone regulating the recreative phase of carbohydrate metabolism and is therefore known as the 'rest hormone'.

Profs. Fyodor Primak and Vassily Vasilenko, of the same Institute, working under the direction of Prof. Nikolai Strazhesko, are studying a number of clinical problems in war medicine, in particular the working out of methods of oxytherapy. They are successfully continuing their study of the process of re-establishing the role of the hæmato-parenchymatose barrier in the human organism.

The Institute of Biochemistry has achieved very important results since the War began. The researches of Prof. Alexander Palladin, director of the Institute, into problems of the biochemistry of vitamins and the biochemistry of foodstuffs in general are of very great importance.

The Institute of Biochemistry is also carrying out research into the biochemistry of the nervous system and the biochemistry of muscular action in connexion with problems raised by clinical medicine, including the problem of the struggle against fatigue.

The Institute of Botany has been working since war began on the cataloguing and utilization of wild plants for defence purposes, and on increasing the output of agricultural products, both foodstuffs and industrial raw materials, to cover the needs of the army at the front and the people behind the lines.

The wild plant life of the Republic of Bashkiria, which is very rich in medicinal herbs, is being studied under the direction of Dr. Mikhail Kotov. A number of leaflets and pamphlets on the "Medicinal Herbs of Bashkiria" have been published. A number of wild-growing food and industrial plants are being utilized as the result of an Academy expedition.

The Agrochemical Section of the Institute of Botany has rendered great war-time service. Prof. Pyotr Vlasiuk has worked out methods of fertilization and farming processes for the cultivation of sugar beet and kok-saghyz, both of which are new crops in the eastern districts of the Soviet Union.

Prof. Nikolai Grishko, director of the Institute of Botany, is continuing his research into the sex genetics of hemp, employing the bi-sexual forms which he has produced in which male plants turn into female at the end of the vegetation period. The improvement of a sort of hemp which he produced earlier is being worked on. This sort is bi-sexual, both sexes reaching maturity simultaneously, making it possible to reap the crop entirely by mechanized methods.

Prof. Andrei Sapegin, who produced new sorts of winter wheat and barley which before the War were sown on 3,750,000 acres, is studying genetic processes of the reproductive organs of cultivated plants.

The laboratories of the Institute of Botany are working on new methods of the selection of hybrid pollen-bearing plants, in particular maize, and studying a number of problems in the cyto-embryology of plants. All this work aims at an increase in the output of agricultural products and an increase in war harvests.

OBITUARIES

Lady Lockyer

AFTER a long and active life devoted to wide social and scientific interests, Lady Lockyer, widow of Sir Norman Lockyer, died at Sidmouth on September 9, following a few days illness. She was ninety-one years of age, and her earthly body now rests in the little churchyard of Salcombe Regis close to that of her husband, who was buried there twenty-three years ago. The Norman Lockyer Observatory on the summit of Salcombe Hill is an outward and visible sign of the exaltation of their spirit to the skies.

Lady Lockyer was the younger daughter of Mr. S. W. Browne, and she with her sister, the late Miss Leigh Browne, became associated with Sidmouth from their childhood days through prolonged visits to their grandparents, Captain and Mrs. Carslake. When living in London they were students at Queen's College, which was founded in 1848 by F. D. Maurice, Henry Morley and other men of "light and leading" to provide scholarly training for girls. The two sisters took an active part in social work in Whitechapel associated with Canon and Mrs. Barnett at Toynbee Hall, and in other public affairs and women's movements. They were the prime movers in the establishment of the first hall of residence for women students in London. An appeal was made for funds to provide such accommodation for women students at University College and the London School of Medicine for Women, and in 1882 the Misses Browne took the lease of a house in Bloomsbury for a term of twenty-one years and placed it at the disposal of a committee appointed to carry out the project.

The first student to come into residence was Miss Cicely Ullman (later Mrs. Sidgwick), and the house was soon full. It became clear that a real need had been met and that further accommodation was required. Two adjoining houses were afterwards leased, but when the lease terminated it was decided to build a College Hall in Malet Street on a freehold site and large enough to accommodate 112 students. The foundation stone of this Hall was laid in October 1931, when Lady Lockyer gave an address on its origin and growth. The new Hall was opened by Queen Mary in 1932 and became the chief residential centre for nearly two hundred women university students in London, until it suffered very severe damage from enemy action during the present War.

Lady Lockyer was the widow of Mr. B. E. Brodhurst, F.R.C.S., when she and Sir Norman were married in 1903. In the same year Sir Norman was president of the British Association, and her gracious presence will be remembered by many members who attended the Southport meeting. Later, they left their London house and occupied one built for them facing the sea on the picturesque slopes of Salcombe Regis. After taking up residence in this house, Sir Norman decided that the summit of Salcombe Hill was admirably suited for an astronomical observatory, as it possesses an unbroken horizon in every direction. With characteristic energy he set about constructing an observatory on this site in 1912. About seven acres of land were presented for the site by Sir Norman and Lady Lockyer, and a number of their friends made generous gifts to build and equip this Hill Observatory, as it was first named. In 1916 the Observatory was formed into a corporation to promote its development, and all the lands, buildings and equipment were conveyed to that body. The name was changed to that of the Norman Lockyer Observatory and the management and control were vested in a council of astronomers and other men of science.

In addition to the land on which the Observatory is situated, Sir Norman and Lady Lockyer contributed during their lifetimes sums amounting to about £11,000 to the Observatory, as well as valuable instruments. Sir Robert Mond, who was chairman of the Corporation until his death in 1938, had a new photographic equatorial constructed and a building erected to house it, his gifts amounting to about £7,500. Sir Francis McClean presented the fine twin-telescope used by his father, Dr. Frank McClean, and other gifts amounting to about £10,000, and his brother, Captain W. N. McClean, has contributed about £5,000 to the funds of the Observatory in addition to designing the domes of the chief instruments and supervising their construction. No other observatory in Great Britain has been built, equipped and maintained on this rich scale of donations from private benefactors.

By Lady Lockyer's death, the Observatory is provided with additional means for its development, in which she always took the keenest interest, and of which she was the honorary treasurer until her death. She has bequeathed to the Observatory Corporation the freehold house at Salcombe Regis in which she and Sir Norman lived, and most of its contents, as well as about forty acres of land up to the summit of the hill on which the Observatory stands, and a farm of eighteen acres and a cottage. It is rarely that such substantial benefactions are made in Great Britain for the advancement of astronomy, though they are common in the United States. They ensure permanent provision for purely scientific research at a time when attention is chiefly concentrated on investigations of possible industrial or other practical value. All who are interested in the pursuit of knowledge and the intellectual expansion produced by it will pay grateful tribute to the spirit and service by which Lady Lockyer used her faculties and means with wisdom and social understanding, not only during her life, but also provided for the continuance of this influence after she had passed into silence.

Lady Lockyer was elected a fellow of the Royal Astronomical Society in 1923, a few years after the Society had decided to admit women into its fellowship. Her cheerful and stimulating presence will be greatly missed by all who came into contact with her and she will long remain in esteemed and cherished memory. R. A. GREGORY.

Mrs. Thoday

MRS. MARY GLADYS THODAY (*née* Sykes), whose death at the age of fifty-nine occurred on August 9, will long be remembered as a keen and versatile botanist. A distinguished student of Girton College, Cambridge, she obtained first-class honours in both the first and the second part of the Natural Sciences Tripos, after which she commenced research work in botany first as Bathurst student and later as fellow of Newnham College.

Attracted to cytological work, she published some interesting contributions on the structure and the division of the nucleus in Funkia and also some important accounts of the histology of several of the Laminariaceæ and the histological relations between Cuscuta and its hosts. But her active mind was many-sided in its interests, and even while engaged in the researches just mentioned she turned her attention to the anatomy and morphology of some of the peculiar vascular cryptogams like Psilotum and Tmesipteris, also of the Gnetaceæ; publishing accounts of first-rate importance of both groups in the *Annals of Botany* and the *Philosophical Transactions of the Royal Society*. She also collaborated with one of her contemporaries at Cambridge, David Thoday (now professor of botany at University College, Bangor) in work on the physiology of plants and in genetics. Those who remember the eagerness of her mind at this time are not surprised at the remarkable output of her scientific work.

In 1910 she married David Thoday, but family cares did not interrupt her botanical work, and when her husband was appointed lecturer in plant physiology in the University of Manchester she was elected honorary research fellow in the University, and in addition to her private investigations she took some share in the botanical teaching. On their removal to Cape Town, where Thoday was appointed to the professorship of botany in 1919, Mrs. Thoday joined her husband in the study of the flora of South Africa on extensive botanical excursions and also continued her investigation of the Gnetales, and at the request of Prof. Seward revised and completed the authoritative book on this group of plants which the late Prof. H. W. Pearson had left unfinished and on which she expended much time and labour. After the return of the Thodays to Great Britain, Mrs. Thoday's interest in botany continued, and she was appointed honorary lecturer in botany in the University College of North Wales.

During a visit to Canada with the British Association in 1924 she collected material of the minute mistletoe *Arceuthobium pusillum*, and an investigation on this plant was begun on the lines of her earlier work on Cuscuta, but it was left unfinished owing to her serious illness.

During the War of 1914–18, Mrs. Thoday threw herself actively into the constitutional movement for women's suffrage, and while in South Africa she became interested in native welfare and the complex racial problems which beset that country.

After a serious illness in 1925 public affairs again claimed her interests and she gave an increasing amount of her time and energy to the promotion of international understanding and goodwill. The deterioration of the European situation towards the end of 1938 played no small part in her tragic breakdown in health in 1939, from which she never fully recovered. Those who know the prodigious amount of secretarial and organizing work, as well as public speaking, which she accomplished during the years 1925–38, can well imagine how much she might have continued to contribute to botanical knowledge in a peaceful world. Her four sons are all serving overseas.

F. E. WEISS.

Dr. H. G. Baynes

DR. H. GODWIN BAYNES, who died on September 6, was the leader of the Jung school of analytical psychology in England. His chief interest was not always, however, directed towards the intangible gossamer of the soul. He was a man well over six feet high, with breadth not belying his height, and with physical powers that gave him his 'blue' and led him in his university days to row for Cambridge against both Harvard and Oxford.

Educated at Trinity College, Cambridge, he became house physician at 'Barts' during 1909–10. He acted as surgeon in the Red Crescent Mission to Turkey in the Balkan War of 1911–12, and after an interval of general practice at Wisbech became captain in the R.A.M.C., and in this capacity served in France, Mesopotamia and Persia. After the War of 1914–18 he took up a post on the resident staff at the Maudesley Hospital, and it was in connexion with his psychiatric work that he became, during 1919–22, assistant to Prof. (then Dr.) C. G. Jung in Zurich.

This was the turning point in Baynes' career. Henceforth his energies were devoted, both through the practice of psychotherapy and through the printed word as well as by means of numerous addresses to public and private bodies, to the dissemination of Jung's psychological doctrines. He not only translated Jung's major scientific work "Psychological Types" and edited and translated his "Contributions to Analytical Psychology" and "Two Essays on Analytical Psychology", but also wrote, in addition to numerous papers on psychiatry, medicine and folklore, a 900-page work entitled "Mythology of the Soul", and a last work on "Germany Possessed".

Baynes also organized and took part in the expedition which Jung made to East Africa during 1925–26 for the purposes of psychological research among the Massai tribes of Mount Elgon in Kenya.

Psychologists are apt to be thought of as formidable, if at times misguided, intellectuals. Baynes was far removed from such a category. Large-hearted as well as large-limbed, he added to his technical knowledge a warmth and sympathy that gave heart and assurance to those whom he helped to find their way, through the labyrinthine passages of the soul, towards that state of integration which results from a full recognition of the healing factors that lie buried in the collective unconscious in which he was such a firm believer. His loss is keenly felt by numerous patients and yet more numerous friends, and not least by the members of the Analytical Psychology Club in London, which he founded and led until his untimely death in full vigour at the comparatively young age of sixty-two.

John Layard.

Dr. L. F. Barker

Dr. Lewellys Franklin Barker, the eminent American anatomist and physician, who died after a long illness at Baltimore on July 13, was born at Norwich, Ontario, on September 16, 1867. He received his medical education at Toronto, Leipzig, Munich and Berlin, and qualified in 1890 at Toronto, where he worked at the general hospital for a year, and from 1894 until 1900 was attached to the Johns Hopkins University as associate professor of anatomy and pathology. From 1900 until 1905 he was professor of anatomy at Rush Medical College, Chicago, and for the next eight years was professor of medicine and chief physician at Johns Hopkins Hospital; he was appointed emeritus professor in 1921.

Prof. Barker was a prolific writer both on anatomical and medical subjects. His anatomical work included a translation of Spalteholz's "Hand Atlas of Human Anatomy" (1933), "Laboratory Manual of Human Anatomy" conjointly with Dean DeWitt Lewis and D. G. Revell (1904), and "Anatomical Terminology with special reference to the B.N.A." (1907); his chief medical works were "Tuesday Clinics at Johns Hopkins Hospital" (1922) and "Clinical Diagnosis of Internal Diseases" (1923), "Degenerative Diseases" with T. P. Sprunt (1925) and "Rheumatism; its Meaning and its Menace" (1926). He was also editor of "Endocrinology and Metabolism", by ninety-eight contributors (1922–24), in which he wrote part of the section on the parathyroid glands. His last works were "Psychotherapy" (1940) and his autobiography entitled "Time and the Physician" (1942).

In 1931–32 in honour of his sixty-fourth birthday, *International Clinics* published a Lewellys Barker *Festschrift* to which more than forty medical men contributed, including the well-known historian Fielding H. Garrison, who summarized his character as follows: "An austere devotion to duty and the things of the mind is set off by a distinction of appearance, a charm of personality, an hospitable nature, an open-minded freedom from prejudice, an innate kindliness of disposition, which are by no means least among the attributes of the beloved physician".

He received many honours, being hon. M.D. of the University of Toronto and LL.D. of Queen's University, Kingston, Ontario, and McGill University, Montreal. He was vice-president of the American Medical Association (1916–17), president of the Association of American Physicians and the American Neurological Association. He also enjoyed a European reputation, being foreign member of the Budapest Royal Society of Physicians, the German Society for Internal Medicine and Children's Diseases, the Medico-Chirurgical Society of Edinburgh and the Swedish Medical Society.

J. D. Rolleston.

Dr. H. C. H. Townend

Dr. Herbert Charles Henry Townend, who was accidentally killed on August 19, was born in London on March 18, 1896, and was educated privately. In 1915, he enlisted as a private in the Honourable Artillery Company and after receiving a commission in the London Regiment was attached to the Royal Air Force as an observer and served in Salonika, Egypt and Palestine. On returning to civil life, in 1919, he became a student at the Northampton Polytechnic, University of London, and obtained the B.Sc.(Eng.) (Lond.) degree, with first-class honours, in 1923. In October of that year he joined the staff of the National Physical Laboratory as a scientific officer. He took part in experimental work in the Aerodynamics Department covering a number of different subjects, but was best known to the outside world as the inventor of the Townend ring, a cowling device used to reduce the drag of the exposed cylinders of air-cooled engines. He made this discovery by accident when engaged on work with quite a different object, a chance observation directing his thoughts in a direction which ultimately led to the development of the ring. Townend was granted a patent on the device and it was at one time very widely used. For his work in this sphere he was awarded the Silver Medal of the Royal Aeronautical Society in 1931 and was awarded a D.Sc.(Eng.) (Lond.) in 1932. Dr. Townend was elected an associate fellow of the Royal Aeronautical Society in 1930 and a fellow in 1933. He was also an honorary scientific member of the Institute of the Aeronautical Sciences of the United States.

Townend's greatest contribution to the service of aerodynamics, however, was his fundamental study of the properties of turbulent flow. He devised an exquisite technique in which tiny spots of hot air were produced by minute electric sparks at various points in the field of flow to be examined, and the subsequent motion of these 'hot spots', as he called them, was observed by cinema-photography. By these means he was enabled to follow the details of the turbulent motion, and the results of his investigations have been of great value in the subsequent development of the subject. He was a brilliant experimenter, one of those rare men who can improvise apparatus out of almost nothing, fit it up with their own hands, and produce important results by its use. This characteristic showed itself also in his private life, for one of his favourite hobbies was the invention and construction of very clever, but very simple, mechanical toys, some of which reached the Patent Office and the general public.

In 1937, Townend left the National Physical Laboratory and joined the staff of the Admiralty as an adviser on aerodynamic problems. The nature of his work was now completely changed, and instead of making experiments himself on a particular subject, he found himself supervising the experimental work of others and taking a broad view of the whole field of aerodynamics as it affected the problems of the Fleet Air Arm. That he was as successful in this as he had been as an original investigator is ample testimony to his great gifts and his clear vision. He maintained a very close contact with the National Physical Laboratory and was a frequent visitor to his many friends and former collaborators there. He had a delightful personality, and was a very interesting conversationalist. His many friends will feel a deep personal loss, and the science of aerodynamics has undoubtedly lost one of its most brilliant exponents.

WE regret to announce the following deaths :

Dr. J. J. C. Bradfield, C.M.G., Australian representative on the Council of the Institution of Civil Engineers during 1936–39, formerly chief engineer of the Sydney Harbour Bridge, aged seventy-five.

Prof. A. E. Bunge, professor of statistics in the University of Buenos Aires and director-general of national statistics, aged sixty-three.

Mr. Paul R. Crimp, student probationer at the Laboratory, Plymouth, and whaling officer, Ministry of Agriculture and Fisheries, in North Africa, aged thirty-one.

Prof. H. Lundborg, professor of racial biology in the University of Uppsala.

Prof. J. M. MacFarlane, emeritus professor of botany in the University of Pennsylvania, aged eighty-seven.

Dr. E. J. H. Mackay, the well-known archæologist, on October 2, aged sixty-three.

Prof. Peter Mühlens, director of the Bernard Nocht Institute for Naval and Tropical Diseases, Hamburg, aged sixty-seven.

Prof. A. A. Read, emeritus professor of metallurgy in the University College of South Wales and Monmouthshire, Cardiff, on September 24, aged seventy-five.

NEWS and VIEWS

Fisheries of Mauritius: Appointment of Dr. J. F. G. Wheeler

DR. J. F. G. WHEELER, lately director of the Bermuda Biological Station for Research Incorporated, has been appointed marine biologist in Mauritius. Dr. Wheeler was assistant lecturer in zoology at the University of Bristol and during 1924–31 was naturalist on board the R.R.S. *Discovery* engaged on whaling investigations in the Antarctic, before taking up his duties at Bermuda. The object of the Mauritius appointment is to obtain for Mauritius the services of an expert to examine the marine and freshwater fisheries with a view to the possible establishment of a permanent fisheries control organization to improve existing nutrition standards of the islanders. It is hoped that Dr. Wheeler's researches may be a prelude to the establishment of a Fisheries Department for Mauritius as a permanent institution. The present scheme for the development of the island's fisheries has been made possible by a free grant up to £4,500 under the Colonial Development and Welfare Act, 1940.

Copernicus

THE Selby Lecture, delivered on May 27 by Sir Harold Spencer Jones, the Astronomer Royal, at Cardiff was on Copernicus (Cardiff: Univ. of Wales Press Board. 1*s*. 6*d*. net). The lecture covers much the same ground as the article by the Astronomer Royal contributed to NATURE of May 22, but a few additional points are worth noticing. For a long time after the publication of "De Revolutionibus", it was believed that Copernicus was the author of the prefatory note which stated that it was not necessary that the hypotheses advocated should be true or even probable ; it was sufficient that they should lead to results in agreement with observation. Although Osiander wrote the prefatory note without Copernicus's knowledge, this was not known at the time, and there was a widespread belief in the sixteenth century that Copernicus had advanced his theory merely as a mathematical device which he did not consider corresponded to any physical reality. Another very interesting matter should be mentioned. Although Copernicus accepted the value for the solar parallax found by Hipparchus, namely, 3′, which implied that an astronomical unit was about one twentieth of its true value, yet the relative mean distances of the planets from the sun, obtained by Copernicus, were remarkably accurate when compared with the most recent determinations. Objections to the Copernican system arose *inter alia* on the question of the distance of the stars, and opponents contended that Copernicus had assumed a great distance for the stars merely to obviate the serious difficulty that they showed no parallax. This was the main reason for the rejection of the Copernican system by Tycho Brahe, and his substitution of a geocentric system in which the sun and moon revolved round the earth, but all the other planets revolved round the sun. Copernicus would not commit himself to any definite statement regarding the infinite distance or otherwise of the stars, and Bruno is usually regarded as the pioneer of the conception of an infinite universe and an infinite number of worlds, though he was anticipated in this by Thomas Digges.

THE recent issue of *Polish Science and Learning* (London : Oxford University Press) is devoted to articles dealing with the life and work of Copernicus, prepared in connexion with the quatercentenary celebrations held earlier this year. One of these is by Sir Harold Spencer Jones, the Astronomer Royal (see NATURE, May 22, p. 573); another, by Prof. H. Dingle, was referred to in the same issue (p. 576). In addition, Prof. St. Kot has contributed an address entitled "The Cultural Background of Copernicus", which shows how greatly indebted Copernicus was to the University of Cracow for his cultural polish. From letters written at the time, we learn that his university life was spent in an atmosphere which favoured independence of thought, enthusiasm for research, and provided the opportunities for developing universal, unfettered personalities. Mathematics and astronomy were predominant in the University, and humanist poetry also took a prominent place. Cracow was the only university north of the Alps in the fifteenth century which had two chairs of astronomy, and several of Copernicus's fellow-students devoted themselves to the study of astronomy and geography. Although he carried out prolonged studies after leaving Cracow in Bologna, Rome, Ferrara, and Padua, the University of Cracow was the first to take an approving interest in his discovery, and the professors there were the first to use Copernicus's astronomical calculations.

H. Kucharzyk has an article entitled "The First Disciples of Copernicus in England (Early English Copernicana)", which deals with the evolution of astronomy in England in the second half of the sixteenth century. The first English scientific man who was a real adherent and ardent supporter of the Copernican idea was Thomas Digges (1546–59), who was known as an astronomer and also as one of the leading mathematicians of Elizabethan times. His work, "A Perfit Description . . .", which appeared in 1576, is regarded as the principal English treatise on the Copernican system printed before the second quarter of the seventeenth century. H. Kucharzyk has also a short article with the title "Copernicus as Economist, Statesman, and Poet", and shows Copernicus's knowledge of monetary questions. In his treatise "De Monetæ Cudendæ Ratio", published in 1526, he formulated the principle which was later known as Gresham's Law, that bad money in circulation with good will drive out the good. His work in political spheres, as a physician, administrator, commander-in-chief of the beleaguered city of Olsztyn, and also as a poet, is dealt with very briefly in this article.

Mass Asphyxia

IN the tube shelter disaster in March of this year 173 people (28 men, 83 women and 62 children) lost their lives as the result, not of enemy action, but of a woman's fall with a child as the crowd was entering the shelter in a reasonably orderly manner. Others fell on top of the woman and the child, and within a few seconds there was a pile of people 3–4 ft. high. Some three hours later all casualties had been cleared. Some people at the top of the pile were dead, some at the bottom were living. Almost the last person extricated was a girl of about seven, who walked to the first aid post without help. These facts and many more of interest are given by Dr. K. Simpson (*Lancet*, September 11, 1943) in what he claims to be the first detailed scientific record of this very rare type of accident. The paper records the results of autopsies done on the instructions of the Coroner on four selected cases and discusses the causes of the deaths. Simpson points out that the factors causing sudden deaths in the early stages of asphyxia are little recognized; such deaths are usually accidental or due to criminal action and can scarcely be reproduced for quiet physiological experiment.

The causes of the deaths of these people were found to be complex. The author points out that asphyxia is not a simple problem. The word means pulseless (from the Greek, *a-sphuxis*), and not prevention of breathing. Three of the cases autopsied showed changes quite out of keeping with prolonged asphyxia. Among other factors that may operate in such accidents are direct compression of the abdomen or chest, constriction of the neck, concussional head injuries, inhalation of vomit and "emotional, reflex neurogenic, local cardiac and more general tissue changes". Parallel factors operate in criminal strangulation and the author discusses these. People may die suddenly at the sight of approaching death or danger or even when they receive bad news or anticipate asphyxia. Impaction of food at the glottis or of water in drowning, garotting, strangling, blows or kicks on the neck, even a brisk current of cold air on the neck, may, in certain individuals, stimulate the carotid sinus reflex and, through this, may cause vasovagal arrest of respiration and the circulation. Bruises and violent hyperextension of the neck, inhalation of vomit, crushing of the chest or abdomen and similar injuries had occurred in the cases autopsied. The author adduces evidence of the rapidity with which local biochemical changes in the heart muscle and in the blood chemistry may occur in asphyxia. When some or all of the factors indicated above are operating together, death can occur very quickly, perhaps within thirty seconds. Apart from the public and biological interest of this paper, it should have, as the author indicates, considerable forensic value.

International Bird Preservation

A JOINT meeting of the British and Polish Sections of the International Committee for Bird Preservation was held in the hall of the Royal Geographical Society on September 25 with Mr. David Seth-Smith in the chair. Dr. Jul. Borucki, representing the Polish Section, spoke on the work for bird preservation done in the past in Poland, directing attention to the fact that Poland and Czechoslovakia set an example to the world by the establishment of the international reserve in the High Tatras. He spoke of the work of reconstruction which would be needed after the War and the peculiar problems of bird preservation which would have to be faced. In a message, Count Wodzicki, chairman of the Polish Section (now Consul-General in New Zealand) stressed the close links which had always existed between the British and Polish Sections; links which had been made closer by the British Section adopting the Polish Section for the duration of the War, an act which symbolized a tribute to the Polish naturalists who had not only lost property and all the results of their scientific work but also their lives.

Mr. Walter E. Higham showed his magnificent colour film of British birds. He took his representative and international audience all over Great Britain, showing in the most exquisite photography different types of landscapes and the birds that are found there: from a typical English garden to the moors and mountains of Scotland, the Lake District, woodlands, fields and hedgerows, the fens, sandy shores and rocky coasts—a film which indeed demonstrates the glories of Britain to the foreigner and should justly make any Briton proud. About thirty species of birds were represented, all of such beauty that it is difficult to make any special mention, but the shots of a shelduck feeding in a shallow pool and reflected in the water are perhaps the highest achievement gained by any Nature photographer. The Belgian Ambassador, in moving a vote of thanks to Mr. Higham, stressed the value of international co-operation in Nature preservation; he mentioned in particular the International Conference on the Preservation of the Fauna of Africa and the proposed conference for the preservation of the fauna of the Pacific, which had to be abandoned on the outbreak of war.

A Part-time Education Scheme

WE have received a copy of an illustrated booklet which is handed to every boy on entering the service of W. T. Henley's Telegraph Works Co., Ltd., and Henley's Tyre and Rubber Co., Ltd. This booklet outlines a scheme which is intended to enable all youths joining the Henley organization to see how they can train themselves for their careers. Every boy is given the option of undertaking a course of training extending over a period of years. Those who have shown that they can benefit from such privileges and have been accepted for the course are released one day a week from their normal works duties to attend approved classes at selected educational institutions near to their place of employment. They are expected to devote themselves wholeheartedly to the courses laid down for them during this day, and to attend a recognized educational establishment of their own choosing on at least one other evening in the week, for which purpose, wherever practicable, they will be released from shift-work or overtime. In addition, they must undertake to carry out the homework in connexion with their day course to the satisfaction of the education authorities. The subjects selected for the day periods are of a more serious and fundamental nature, but a good deal of freedom is given in the selection of subjects for the evening courses. Boys are paid for the time spent at the day establishment, and all fees, both for the day and evening courses, are paid by Henley's. The scheme is intended to produce better workmen, foremen and managers, and also better citizens; in addition to every encouragement being given to the boys to enlarge their mental outlook, physical training classes form an important part of the scheme.

Production of Crop Seeds

THE supply and distribution of seeds of agricultural and horticultural crops has been a problem of major concern since 1939 for countries isolated from Central Europe. The developments that have taken place in their attempt to achieve self-sufficiency in this respect are described in Joint Publication No. 5 issued by the Imperial Bureaux, "The Production of Seed of Root Crops and Vegetables" (price 3*s*.). The creation of the sugar beet industry in the United States market is perhaps the most complete of the accounts published, for it can now meet domestic needs, whereas during 1932–34 dependence on imported seed was absolute. Good results have been obtained with vegetable seed production in Sweden, and provided the right areas are selected the prospect seems promising in Australia, New Zealand and Canada. As regards Great Britain considerable progress has been made, and although Scotland appears to be outside the limits of economic seed production for all but a few vegetable crops, in England the chief advances lie in determining those areas where maximum seed yield can be expected. An interesting development is the investigation into the possibilities afforded by the tropical highlands and by those parts of the Empire which lie in the Mediterranean basin. Much information is provided on the varieties used, seed laws and regulations, and a useful index of crops and varieties is appended. Specialists or members of recognized scientific institutions who are in need of more complete references to the literature on any given section, or of more detailed information on special points, are invited to apply to the Imperial Agricultural Bureaux at East Malling, Aberystwyth or Cambridge.

Earthquakes in Central and South America

THE United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has found the epicentres of three recent earthquakes in Central and South America. The first, on June 30, occurred at 20h. 13·0m. U.T. from an epicentre near lat. 14·5° S., long. 74° W., which is just north of the town of Coracora in Peru. The focus may have been deeper than normal. The second, on July 4, occurred at 9h. 52·1m. U.T. from an epicentre near lat. 9° N., long. 84·5° W., which is near the coast south-east of the town of San José, and due south of the volcano Irazu in Costa Rica. The depth of focus in this instance was possibly 100 km. The third earthquake was on July 5 at 21h. 7·6m. U.T. from an epicentre lat. 17·5° S., long. 73° W., which is immediately off the coast west of the town of Mollendo in Peru. The depth of focus was normal. All these epicentres are in well-known seismic areas and all interpretations and determinations are tentative. Calculations were based on instrumental reports from the seismological observatories at Georgetown, Weston, St. Louis, Pasadena, Philadelphia, Fordham, Tucson, San Juan, Washington D.C., Burlington, Mobile, Buffalo, and Salt Lake City.

Parsons Memorial Lecture

THE Parsons Memorial Fund, which is administered by the Royal Society, made provision for a memorial to the late Hon. Sir Charles Parsons in Westminster Abbey, and for an annual Parsons Lecture to be given under the auspices of eight specified institutions and societies in turn which are concerned with the subjects most closely associated with Parsons' name. In accordance with the terms governing the appointment of the lecturers, the 1943 lecture, which is the eighth of the series, is to be given under the auspices of the Physical Society. It will be delivered at the meeting of the Society at the Royal Institution at 4.30 p.m. on October 15, by the Right Hon. Lord Rayleigh, who has chosen as his subject "Optical Topics, in part connected with Charles Parsons". Previous lectures have dealt more especially with other aspects of Parsons' work.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Interpretation of Patterson Diagrams

The direct F^2 Fourier series of Patterson[1] is one of the most powerful methods in modern crystal analysis, and many of its applications have been described from time to time in Nature[2]. Patterson's original result was derived as an extension of the application to crystals of the theory of scattering of X-rays in liquids made by Gingrich and Warren[3]. Patterson computes the weighted average distribution of electron density ρ about a point in the crystal, cell-size abc, volume v, by the relation

$$A\ (uvw) = \frac{1}{v}\int_0^a\int_0^b\int_0^c \rho(xyz)\rho(x+u,\ y+v,\ z+w)\,dx\,dy\,dz,$$

which gives the distribution about the point as a function of the parameters uvw. Making use of the usual expression for the electron density in terms of the structure amplitudes $F(hkl)$, namely,

$$\rho(xyz) = \frac{1}{v}\Sigma\Sigma\Sigma\, F(hkl)\ \exp 2\pi i(hx/a+ky/b+lz/c),$$

the function $A\ (uvw)$ is obtained as

$$A\ (uvw) = \frac{1}{v^2}\Sigma\Sigma\Sigma\ |F(hkl)|^2\ \exp 2\pi i(hu/a+kv/b+lw/c).$$

The importance of $A(uvw)$ arises because it will only be large when there are high values in $\rho(xyz)$ both at (xyz) and at $(x+u,\ y+v,\ z+w)$. Thus a peak in the function $A(uvw)$ at $(u_1v_1w_1)$ corresponds to an interatomic distance in the crystal defined by a vector the components of which are $(u_1v_1w_1)$.

The success of the method, of course, depends on the fact that the distributions $A(uvw)$, or vector maps, can be calculated *directly* from the crystal measurements, because they only involve the square of the structure amplitudes, which can be directly observed.

Although very useful in dealing with simple structures with only a few outstanding features, the Patterson method becomes involved when applied to structures with large numbers of similar atoms, such as organic structures in general, owing to the excessively large number of interatomic vectors the peaks of which mutually obscure one another in the calculations and defy resolution. The following simple technique has been devised in an attempt to deal with this situation.

It is convenient to restate the Patterson result in very simple terms. Consider a linear arrangement of atoms, co-ordinates $\theta_1,\ \theta_2\ \ldots\ \theta_n$ ($\theta = \frac{2\pi x}{a}$, where a is the axial length). If F_h is the structure amplitude for the hth order, then,

$$|F_h|^2 = (f_1\cos h\theta_1 + f_2\cos h\theta_2 + \ldots + f_n\cos h\theta_n)^2 + (f_1\sin h\theta_1 + f_2\sin h\theta_2 + \ldots + f_n\sin h\theta_n)^2,$$

f_n being the atomic scattering factor appropriate to the nth atom for the plane h. Expanding the terms in the brackets we obtain, with a slight rearrangement,

$$\begin{aligned}|F_h|^2 = {} & f_1f_1\cos h(\theta_1-\theta_1) + f_1f_2\cos h(\theta_1-\theta_2) + \ldots + f_1f_n\cos h(\theta_1-\theta_n)\\ & + f_2f_1\cos h(\theta_2-\theta_1) + f_2f_2\cos h(\theta_2-\theta_2) + \ldots + f_2f_n\cos h(\theta_2-\theta_n)\\ & + \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\ \cdot\\ & + f_nf_1\cos h(\theta_n-\theta_1) + f_nf_2\cos h(\theta_n-\theta_2) + \ldots + f_nf_n\cos h(\theta_n-\theta_n).\end{aligned}$$

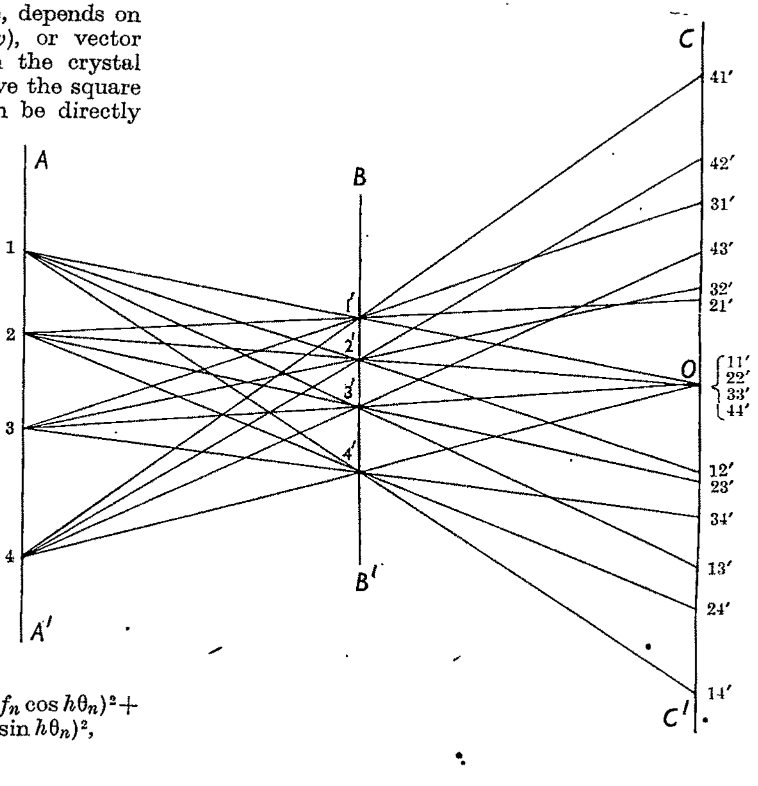
We note that the cosine terms contain all the interatomic distances in the structure, and that the coefficient of each term is the product of the atomic scattering factors appropriate to the pair of atoms concerned. This is, in effect, the Patterson result. Instead of a distribution of atoms or scattering centres, $\rho(x)$, we have to consider a distribution of interatomic vectors, $A(u)$. If this is represented by a Fourier series in the usual way, then the coefficients are $|F_h|^2$, of which there is an infinite series.

If the atoms are numbered 1, 2, . . . n, as above, the array of vectors may be written

$$\begin{array}{cccc} u_{11} & u_{12} & \ldots & u_{1n} \\ u_{21} & u_{22} & \ldots & u_{2n} \\ \cdot & \cdot & \cdot & \cdot \\ u_{n1} & u_{n2} & \ldots & u_{nn} \end{array}.$$

The diagonal terms $u_{11},\ u_{22},\ \ldots\ u_{nn}$ express the condition that every atom is at zero distance from itself, and the other terms $u_{12},\ u_{21}$, etc., occur in symmetrical pairs. There are thus only $\frac{n(n-1)}{2}$ terms which are essentially distinct. Nevertheless, this is a large number even for structures containing only a moderate number of atoms, and consequently there is little hope of locating the individual peaks in the Patterson diagram.

In this connexion the following simple construction is useful.



The points 1, 2, 3, 4 on *AA′* in the diagram are joined by straight lines to the point *O* on the parallel line *CC′*. The intersections, 1′, 2′, 3′, 4′, on some intermediate parallel line *BB′* are marked. A line is then drawn from each point on *AA′* to each point on *BB′* and produced to *CC′*. The array of points on *CC′* is then the vector map of the points on *AA′*. The construction is equally valid in two dimensions, with the points distributed on planes at *AA′*, *BB′*, and *CC′*.

If the points 1, 2, 3, . . . are movable light sources connected by thin elastic threads to *O*, and each thread carries a small light sphere at *BB′*, then the shadow pattern produced on the screen at *CC′* corresponds to the Patterson projection of the structure at *AA′*. The shadows will overlap and merge in some places, and in particular there will always be an intense shadow at the origin *O*, as in the Patterson distributions. The shadows can be adjusted to correspond very roughly to atomic contours by varying the size and intensities of the light sources.

The advantage of the method lies in the fact that as the atomic positions on *AA′* are varied, the resulting Patterson projection can be followed continuously. Now, the Patterson projection of any unknown structure can be calculated directly. To solve the structure, therefore, we have to vary the possible atomic positions until a good 'fit' is obtained. It is only rarely, of course, that one can deal with a small isolated group of atoms, as shown in the diagram. In general, parts of the adjoining unit cells will have to be included.

The method seems to have distinct possibilities in dealing with structures containing moderate numbers of similar atoms, and it is also an interesting lecture experiment. It is possible to abolish the rather troublesome threads and small spheres by using properly placed photographic plates and negatives, and the method outlined above also has the virtue of continuous variation.

J. MONTEATH ROBERTSON.

Chemistry Department,
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Sept. 1.

[1] Patterson, A. L., *Phys. Rev.*, 46, 372 (1934); *Z. Krist.*, 90, 517 (1935).

[2] See NATURE, 142, 581, 955, 994 (1938); 143, 75 (1939); 149, 491 (1942); 150, 324 (1942).

[3] Warren, B. E., and Gingrich, N. S., *Phys. Rev.*, 46, 368 (1934).

A New Criterion for Expressing the 'Intensity of Firmness' of Soft Bodies

Nutting[1,2] has proposed, and Scott Blair and Coppen[3,4], Broome and Bilmes[5,6], Couzens and Wearmouth[7], Lethersich[8] and Haward[9] have developed and applied, an equation expressing the shear strain (σ) in soft materials as proportional to a power (β) of the shear stress (S) and also to a power (k) of the time (t) of its application. This equation may be written:

$$\sigma = \psi^{-1} S^{\beta} t^{k}, \qquad (1)$$

where ψ is an intensity or proportionality factor which, unlike β and k, has complex dimensions.

Since $1/\psi$ is defined as the strain produced by unit stress in unit time, a comparison of the firmness of materials having different β and/or k values in terms of ψ is in any case arbitrary. Moreover, the usual unit of force (1 dyne) being very small compared with the stresses normally required, these values of ψ are not only arbitrary but are apt also to be misleading. Although this latter difficulty can be obviated by using a larger unit of force, ψ still represents no more than a point within a three-dimensional diagram.

The intensity factor cannot, in the nature of things, be expressed in terms entirely independent of arbitrary conditions: but a great improvement can be effected if we use, for purposes of comparison, instead of ψ, a property ζ, defined as the reciprocal of the volume of the $S : \sigma : t$ figure integrated between the limits of the greatest ranges of stress and time likely to be used in practical testing.

As an example, for materials which are readily deformed by squeezing in the hands ("soft bodies"), Scott Blair and Coppen[10] have shown that stresses of the order of 10^6 dynes/cm.^{2} are normally exerted. For studying such materials, a convenient range of stress would be 0–10^6 dynes/cm.^{2} and of time 0–100 sec.

Indicating these limits by their logarithms as suffixes, we have, for the volume of the selected figures:

$$1/\zeta = \int_0^{S_6} \int_0^{t_2} \sigma . dS . dt. \qquad (2)$$

Substituting from equation (1) and integrating:

$$1/\zeta = \psi^{-1} \frac{1}{\beta+1} \frac{1}{k+1} S_6^{\beta+1} t_2^{k+1};$$

or, writing σ_m for maximum strain and taking logarithms:

$$\log \zeta = \log (\beta+1) + \log (k+1) - 8 - \log \sigma_m \qquad (3)$$

Log σ_m can either be determined experimentally or, more usually, calculated from experimental data for lower values of S and t, using equation (1).

Scott Blair and Caffyn's[11] suggestion that the deformation properties of soft materials should be described by plotting log ψ vertically on the base of a 'Nutting square' having β and k as horizontal co-ordinates is thus improved by substituting log ζ for log ψ.

For the special cases of an elastic solid ($\beta = 1$, $k = 0$) and a viscous fluid ($\beta = 1$, $k = 1$) it is easy to express ζ in terms of shear modulus and viscosity. It is not, of course, a fluidity, in spite of its dimensions ($M^{-1}LT$), which are independent of equation (1). Notwithstanding the necessity for fixing limits in the integration defining ζ, this treatment often provides better criteria of the behaviour of complex materials under stress than do viscosities and shear moduli, since the former usually fall in a complex manner with rising stress and rise with increasing strain, and the latter are frequently dependent on the stress history of the sample.

I am indebted to Dr. F. M. V. Coppen and to Mr. L. Bilmes for helpful discussions.

G. W. SCOTT BLAIR.

National Institute for Research in Dairying,
Shinfield, Near Reading.
Aug. 19.

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[2] *Proc. Amer. Soc. Test. Materials*, 21, 1162 (1921).

[3] *Proc. Roy. Soc.*, B, 128, 109 (1939).

[4] *J. Soc. Chem. Ind.*, 60, 190 (1941).

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[6] NATURE, 147, 176 (1941); 149, 412 (1942).

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[8] Brit. Elec. and Allied Ind. Res. Assoc. Report No. L/T 14.

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[10] *Amer. J. Psychol.*, 55, 215 (1942).

[11] *J. Sci. Instr.*, 19, 88 (1942).

Structure of the Eta Phase of the Iron-Silicon System

THE crystal structures of the different phases of the iron-silicon system have been worked out by Phragmen[1] with the exception of one, which he described as Fe_3Si_2 (25·0 per cent Si). This phase usually appears together with α (solid solution of silicon in ferrite) or ε (FeSi). The composition seems to correspond to 23–25 per cent Si, but it is difficult to obtain it in a pure form. Furthermore, Greiner and Jette[2] showed that the η phase was stable only between 825 and 1030° C.

Osawa and Murata[3] described this phase as Fe_5Si_3 (23·1 per cent Si) and succeeded in indexing the lines on the basis of a hexagonal unit cell with:

$$a = 6{\cdot}727_5 \text{ kX.}, \quad c = 9{\cdot}411_2 \text{ kX.}, \quad \frac{c}{a} = 1{\cdot}398_9.$$

Experimental work carried on here supports their conclusions except that we find the c axis to be only half this length[4].

It was then realized that the powder photographs of Mn_5Si_3 and Fe_5Si_3 show a great similarity. Comparative measurements of spacing, as well as observation of intensities, confirmed this analogy.

The structure of Mn_5Si_3 has been elucidated by Amark, Borén and Westgren[5]; the space group is D_{6h}^{3} (C 6/mcm), and not that previously suggested[4]. The unit cell contains $Mn_{10}Si_6$. The accompanying table gives the particulars of the Mn_5Si_3 and Fe_5Si_3 structures:

	Lattice parameters			Structural parameters[6]		
	a (kX)	c (kX)	$\frac{c}{a}$	4 Mn (or Fe) in (d)	6 Mn (or Fe) in (g) u = 0·23	6 Si in (g) v = 0·60
Mn_5Si_3	6·898 ± 0·005	4·802 ± 0·005	0·696	$\frac{1}{3}$ $\frac{1}{3}$ $\frac{1}{4}$	u u O	v v O
Fe_5Si_3	6·7416 ± 0·0006	4·7079 ± 0·0006	0·69834			

The reason why this similarity has not been noticed before is probably that different authors found some difficulties in deriving the right formula for the phase. Borén[7] studied by X-rays the alloys of silicon with chromium, manganese, cobalt and nickel. He observed the hexagonal phase in the Mn-Si system, but did not remark its similarity with the eta phase of the iron-silicon system. He attributed to the manganese-silicon phase the formula Mn_3Si, while the eta phase of the iron-silicon system was described as Fe_3Si_2. Actually, it now appears certain that they should be described as Mn_5Si_3 and Fe_5Si_3 respectively.

The analogy between the two systems is now evident, as the following comparison shows:

Mn_3Si is a body-centred phase (a = 2·851 kX)[5].

Fe_3Si, or the region of the continuous solid solution of silicon in iron corresponding to this particular composition, is also body-centred (a = 2·8220 kX. ± 0·0003).

Mn_5Si_3 and Fe_5Si_3 are isomorphous, as described above.

MnSi (cubic, a = 4·548 kX. ± 0·002)[8] has the same structure as FeSi (a = 4·4790 kX., the lattice parameter varying with the composition).

The structure of the eta phase was the only unknown one in the iron-silicon system, which is now completely worked out from the crystallographic point of view.

Approval for publication has been given by the Director-General of Scientific Research and Development, Ministry of Supply.

A. R. WEILL.

Cavendish Laboratory,
Cambridge. Aug. 21.

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[2] Greiner and Jette, Amer. Inst. Min. Met. Eng., T.P. No. 744 (1936).

[3] Osawa and Murata, *Nippon Kinzoku Gakkai-Si*, 4, 228 (1940).

[4] Lipson and Weill, *Trans. Farad. Soc.*, 39, 13 (1943).

[5] Amark, Borén and Westgren, *Metallwirtschaft.*, 15, 835 (1936).

[6] International Tables for the Determination of Crystal Structures, vol. 1, 229 (1935).

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[8] Laves, *Z. Krist.*, 89, 189 (1934).

Variation of Serum Composition with the Age of Horses as shown by Electrophoresis

THE results briefly reported below became apparent during the course of systematic examination of samples of sera from a wide variety of sources. A simple modification[1] of the Tiselius electrophoresis apparatus[2] was used in conjunction with the Lamm scale method[3] of recording the migration of the serum components. On the graphs obtained the approximate area of that portion of the curve representing a particular component was measured and the figures expressed as percentages of the total protein. The protein concentrations are given in the table below.

It is apparent that serum of the newly born foal with a relatively low total protein content is characterized by a high albumin and α globulin, only traces of β globulin and a complete absence of γ globulin. At the age of five days the albumin has decreased to a concentration slightly higher than that of the adult animal; this is accompanied by a slight but scarcely significant increase in α globulins, a tremendous increase in β globulins and the appear-

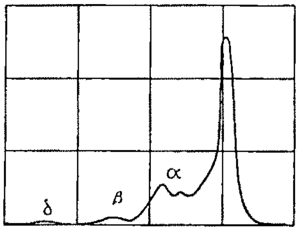

Fig. 1. FOAL BEFORE INGESTION OF COLOSTRUM.

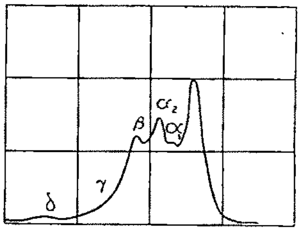

Fig. 2. FOAL 5 DAYS OLD.

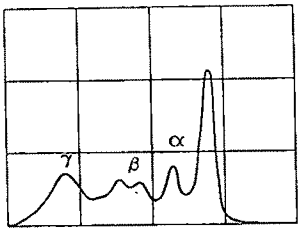

FIG. 3. FOAL 8 MONTHS OLD.

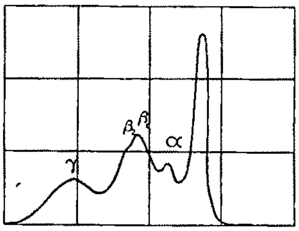

Fig. 4. HORSE 2½ YEARS OLD.

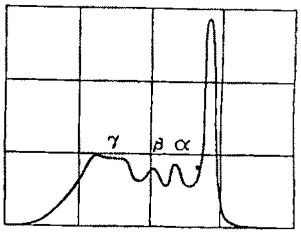

Fig. 5. HORSE 10 YEARS OLD.

Age of horse	Percentage of total protein				Protein conc.
	Albumin	$(\alpha_1+\alpha_2)$ glob.	$(\beta_1+\beta_2)$ glob.	γ glob.	
Newly born	65	32	3	0	3·7
After 5 days suckling	37	36	25	2	5·25
Foal, 8 months	33	14	25	28	6·8
2½ years	30	11	33	26	7·0
10 years	30	11	12	47	7·0

ance of traces of γ globulins. With age the albumins decrease slightly, and the α globulins markedly, to a constant. The β and γ globulins decrease and increase respectively in marked degree so that the total protein concentration remains constant at a figure slightly less than double that of the newly-born foal.

Jameson, Alvarez-Tostado and Sortor[4] reported results on the electrophoresis of calf serum. They showed that the increase in γ globulin is very rapid during the nursing period; in other respects their results resemble the results reported in this communication.

ALFRED POLSON.

Division of Veterinary Services,
Dept. of Agriculture and Forestry,
Onderstepoort, South Africa. July 15.

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[2] Tiselius, *Biochem. J.*, 31, 313 (1937).

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A New Source of Trehalose

ABOUT fifteen years ago the manna of the Sinai desert was identified by Bodenheimer and Theodor[1] as the excretion of the scales *Trabutina mannipara* and *Najacoccus serpentinus* on the leaves of *Tamarix mannifera*. Chemically, the manna was determined as a mixture of sucrose and invert sugar[2].

Recently, Prof. Bodenheimer kindly supplied me with specimens of a manna from the North Iráqian desert (Suleimanyia District). The Bedouin gather this sweet product from leaves of trees and bushes, and use it as a sugar substitute in coffee. It is a half syrupy, half crystalline mass, and is considered by Prof. Bodenheimer to be an excretion of a leaf scale. Chemical analysis showed that its sugar fraction consists mainly of the rare disaccharide trehalose, which could be isolated from the mixture after elimination of the fermentable sugar by yeast, deproteinization, concentration and extraction of the residue with boiling alcohol. It showed the correct optical activity: $[\alpha]_D + 198°$. One manna specimen contained 30 per cent and the other 45 per cent of trehalose calculated on the total dry matter, and 70 per cent and 80 per cent of trehalose calculated on the total carbohydrate content. The remaining carbohydrate consisted of sucrose and invert sugar containing an excess of glucose.

Previously, trehalose has been shown to occur in another rare manna (trehala-manna), which has been identified as the cocoon of an oriental beetle, and in yeast, other fungi, and species of Selaginella[3].

J. LEIBOWITZ.

Dept. of Chemistry,
Cancer Research Laboratories,
Hebrew University, Jerusalem. Aug. 17.

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[1] "Ergebnisse der Sinai-Expedition 1927 der Hebräischen Universität", p. 45 (Leipzig, 1929).

[2] Fodor and Cohn, Ibid., p. 89.

[3] Zemplen, "Biochemisches Handlexikon", 13 (Suppl. Vol. 6), 551 (1931).

Microbiological Assay of Riboflavin

IN 1939, Evans, Handley and Happold[1] used the Strong-Snell[2] method to demonstrate the synthesis of riboflavin, among other elements of the B complex, by *C. diphtheriæ*, and early in 1940 I demonstrated to the Biochemical Society the Strong-Snell technique for the assay of this component. In further studies we became aware of certain pitfalls in the application of this method; our observations being communicated to fellow investigators at a symposium held in Reading a year ago.

Since then full papers on the microbiological assay of riboflavin by Barton-Wright and Booth[3] and by F. W. Chattaway and Mary Sandford and myself[4] have appeared. The formers' paper, which appeared first, does not mention at least two facts of importance which must be considered before the original method of Strong and Snell can be applied, namely, the importance of the calcium level of the medium, and of the additional growth factors, which must be present in the medium in optimal proportions. Both of these points have been conceded in private conversation. It is therefore to be regretted that in their recent communication to NATURE[5] which appears simultaneously with that of Prof. Hopkins[6] there is no mention of these particulars. It seems a pity that we should run the risk of discrediting a potentially valuable line of approach to the rapid assay of the vitamins of the B complex by failing to indicate to all workers in this field the necessity for careful and critical scrutiny of the methods in use before we apply them in a wholesale fashion to the analysis of foods and body fluids and secretions.

FRANK C. HAPPOLD.

Biochemical Laboratories,
School of Medicine,
Leeds, 2.
Sept. 14.

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[1] Evans, W. C., Handley, W. R. C., and Happold, F. C., *Brit. J. Exp. Path. and Bact.*, 20, 396 (1939).

[2] Snell, E. E., and Strong, F. M., *Ind. Eng. Chem.* (Anal. ed.), 11, 346 (1939).

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[5] Barton-Wright, E. C., Moran, T., and Sarson, H. S., NATURE, 152, 273 (1943).

[6] Hopkins, R. H., NATURE, 152, 274 (1943).

DR. HAPPOLD has shown us a copy of his letter criticizing the microbiological assay of riboflavin by our modification of the Snell and Strong[1] method. Had his criticisms been raised against the assay of pantothenic acid using *Lactobacillus helveticus* or nicotinic acid using *L. arabinosus* (Snell and Wright[2]) we would have been in partial agreement, but as regards riboflavin assay they have no justification.

Further, we would point out that our paper was submitted for publication a fortnight before the Reading symposium (held September 25, 1942), while we certainly have never conceded in private conversation the point that Dr. Happold raises.

The Snell and Strong medium uses photolysed peptone and yeast extract for the necessary remaining factors other than riboflavin required in optimum amount. The main reason for the success of the riboflavin assay by this method and lack of success with some other members of the B_2 complex is due to the fact that the riboflavin is easily removed from peptone and yeast without destroying the other factors. Peptone itself contains an unknown factor which is required in high concentration by *L. helveticus* and also *L. arabinosus* and *Streptococcus lactis* (Pollack and Lindner[3], and our own unpublished observations). Our main difficulty, for example, in the microbiological assay of nicotinic acid has been to free the peptone of its nicotinic acid without at the same time removing this unknown factor.

Chattaway, Happold and Sandford[4] have described a 'synthetic' medium using hydrolysed casein in place of peptone for the assay of riboflavin, and have stressed the need for $Ca^{\cdot\cdot}$ to be present. This medium, however, suffers from the fundamental defect that it contains no sodium acetate, and is therefore insufficiently buffered (Stokes and Martin[5] and our own unpublished observations). In so far as calcium chloride is a very much less satisfactory buffer than sodium acetate it fails to maintain the desirable *p*H for optimal growth and acid production—if a suitable amount of sodium acetate be present in the medium the presence of Ca ions has no effect one way or the other on the titrations.

Further evidence for the inadequacy of the medium used by Chattaway *et al.* is shown (1) by the fact that they were unable to obtain satisfactory values for the riboflavin content of certain foodstuffs; (2) the fact that its sensitivity in response to added riboflavin is very low—0·1–0·8 μ gm./10 ml. medium, cf. Fig. 1 (Chattaway *et al.*) with a maximum titration of 6 ml. N/10 NaOH. With the Snell and Strong medium the range of riboflavin used varies from 0·05 to 0·2 μ gm. and the maximum point is reached at 0·25 μ gm. The titration value here is between 17 and 18 ml. N/10 NaOH/10 ml. of medium.

Finally we would point out that it can scarcely be mere coincidence that assays carried out by the microbiological, fluorometric and biological methods on the same material all agree within experimental error (Barton-Wright and Booth[1], Copping[6]). This agreement has since been extended to mixed diets, the results of which will shortly be published.

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R. GORDON BOOTH.

Cereals Research Station,
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Old London Road,
St. Albans.
Sept. 18.

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[1] Barton-Wright, E. C., and Booth, R. G., *Biochem. J.*, **37**, 25 (1943).

[2] Snell, E. E., and Wright, L. D., *J. Biol. Chem.*, **139**, 675 (1941). Pollack, M. A., and Lindner, M., *J. Biol. Chem.*, **147**, 183 (1943).

[4] Chattaway, F. W., Happold, F. C., and Sandford, M., *Biochem. J.*, **37**, 298 (1943).

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[6] Copping, A. M., *Biochem. J.*, **37**, 12 (1943).

An Alumina Hydrogel

SOLS of hydrous alumina are generally prepared either by the hydrolysis of aluminium acetate solutions, or by the peptization of freshly precipitated hydrous alumina. Such sols are converted to gels by the addition of a suitable small amount of electrolyte, and the gels so formed are thixotropic at concentrations so low as 1 per cent Al_2O_3 [1].

Pavelka[2] prepared an alumina sol by the addition of ammonia to an aluminium salt in the presence of boric acid. The following discussion shows how an alumina gel may be formed in the presence of boric acid without the addition of ammonia. The gel is formed simply by cooling a sol of suitable composition, as in the typical preparation of an organic jelly.

In the course of the colorimetric determination of silica in alumina, the alumina was brought into solution by fusion with a mixture containing 2 parts of sodium potassium carbonate to 1 part of anhydrous borax. The melt was afterwards extracted with water, and the aqueous solutions, under certain conditions of concentration and *p*H, were found, on standing, to be converted into gels which exhibited, to a slight extent, the phenomenon of thixotropy.

If a solution containing 4·45 gm. of Al_2O_3 and 17·8 gm. of fusion mixture in 100 ml. was allowed to stand in the cold, it was converted into a gel which, on shaking, was transformed to a viscous liquid. More concentrated solutions (5 gm. Al_2O_3 and 20 gm. of fusion mixture in 100 ml.) formed a brittle gel which became pasty on stirring. If left undisturbed, these gels soon regained their original firmness.

The sol-gel transformation is reversible, since, on warming, the gels were converted into sols. The time required for the cooled sols to be reconverted into gels was found to depend on their concentration. If the most concentrated sol was allowed to stand, a cloudiness and increase in viscosity was observed after half an hour, and the mixture set to a firm gel after an hour. If this sol was diluted to 2·5 times its original volume, so that it contained 2 gm. of Al_2O_3 and 8 gm. of fusion mixture in 100 ml., the cloudiness appeared after three hours and gel formation was complete after forty hours; if the solution was further diluted so as to contain 1·33 gm. of Al_2O_3 and 5·33 gm. of fusion mixture in 100 ml., the cloudiness appeared after twenty-four hours and a gel was formed after four days. All these gels suffered a marked decrease in viscosity on shaking.

In the most concentrated solutions a deposition of boric acid occurred, but this did not prevent gel formation.

The stability of these concentrated gels to acid was also investigated by acidifying the sol with nitric acid and testing its *p*H by means of the glass electrode before gel formation commenced. In this way it was found that a sol with *p*H so low as 2·4 was converted into a gel in the usual way. Addition of more 8 N nitric acid brought about the permanent destruction of the gel.

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Department of Chemistry,
University of Western Australia.

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[1] Freundlich and Bircumshaw, *Kolloid-Z.*, **40**, 19 (1926); Freundlich, **46**, 294 (1928).

[2] *Kolloid-Z.*, **84**, 303 (1938).

Production of Freshwater Fish in Palestine

IN his article on the "Freshwater Fisheries in the British Colonial Empire"[1], Dr. E. B. Worthington stresses the importance of freshwater fish production, but points out that in many parts of the Empire the fresh waters are being neglected. Taking Lake Victoria as an example, he estimates the production of fish in this great tropical lake to be only about 1·4 lb. per acre per year. This "ridiculously small" figure he compares with the North Sea which produces about 15 lb. per acre per year, and explains that in Lake Victoria only the fish of the inshore waters are taken, while the main mass of the water, 26,800 square miles in area, but less than 270 ft. in depth, is left undeveloped and unexploited.

It is interesting to compare these figures with those of Palestine where the fresh waters so far provide one quarter of the total fish production of the country. Apart from the Dead Sea, the largest area of inland water is Lake Tiberias (Sea of Galilee), which is a small, shallow sub-tropical lake, with an area of about 65 square miles and a depth of less than 160 ft. Despite the fact that the Lake has recently been seriously overfished, the catch during 1942–43 was 420 tons. This is a production of 22·5 lb. per acre per year, a figure about seventeen times as high as that of Lake Victoria. Investigations on the composition of this catch show that 76 per cent of the total was contributed by a small open-water cyprinid, *Alburnus sellal*, commonly known as 'sardine'. This little fish appears in the fishery only during four months of the year and is rarely taken above a length of 12 or 13 cm. The remaining 24 per cent of the catch was made up of three large species of Cyprinidæ and five species of Cichlidæ (Tilapia species and related genera) all of which are caught around the shores. If the catches of these inshore fish are considered separately, they show a production of 5·4 lb. per acre, a figure still nearly four times that of Lake Victoria.

The part played by the 'sardines' in the Lake Tiberias fishery is thus an extremely large one at the present time and one which has increased in importance in the last few years. In the past 'sardines' were considered of little value, and as recently as the 1935–36 and 1936–37 seasons, they contributed only 33 per cent of the total catch. The fishery then was not strictly controlled and the stock of fish was being both too intensively and irrationally fished, with the result that each year it was becoming increasingly difficult to get good catches of the larger cyprinids and cichlids. Although overfishing of these species was obviously occurring, the fact was masked in the records of the fishery since these showed a continuous increase in the total catch each year. The explanation is that as the other stocks decreased in size the fishermen turned more and more to the 'sardines' until three quarters of the catch was composed of them. This trend has been accentuated and accelerated by the new restrictions and regulations which were introduced into the fishery in 1942 to protect the stocks of the larger cyprinids and cichlids from destruction. These restrictions, as was expected, reduced markedly the catches of these fishes during the year 1942–43, making even more men concentrate on 'sardine' fishing. Luckily from the point of view of food production, the fantastic prices which the public of Palestine is willing to pay for fish of all kinds has encouraged the fishermen to work harder, so that the catch from the lake has not gone down as a result of the new legislation. Even the 'sardine', once spurned by all but the fellahin, is now in universal demand, and the other main species may realize more than two shillings a pound when landed on the quay.

The only other considerable area of natural fresh water in Palestine is Lake Huleh and its surrounding swamps. Last year this area produced 45 tons of fish. It is difficult to give a figure for production since the boundaries between open water, swamp and dry land are not clearly defined and vary greatly with the seasons. Taking the average area of water which can be inhabited by fish during the year to be not less than 9 square miles, the production is less than 5 lb. per acre per year. Since Lake Huleh is a shallow lake, rich in food, it is surprising to find that at present it is probably yielding less per acre than the inshore waters of the much more barren Lake Tiberias and only about one quarter of the total production of that Lake. In Lake Huleh more extensive cutting of channels in the weed beds is required if the fishery is to give its proper yield.

Turning to the subject of fish ponds, it is again interesting to compare the production in Palestine with that in other countries. In central Europe Dr. Worthington says that "fish farms may produce up to and more than 400 lb. of fish, such as carp and rainbow trout, per acre of water per annum". In Palestine exact figures are impossible as the industry is expanding rapidly, but during last year there were not less than 500 acres of fish ponds in existence which produced more than 200 tons of carp. The production, therefore, is between 800 and 900 lb. of fish per acre per year, which is at least twice as high as that of central Europe. This high figure results from the fact that carp grow very rapidly in the climate of Palestine. They become mature in a few months instead of in two years as in Europe, and may grow from the egg to a weight of more than four pounds in a year.

C. K. RICARDO BERTRAM.

Fisheries Office,
Haifa, Palestine.
July 5.

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[1] NATURE, 151, 353 (1943).

Polyploidy in the Potato

RECOGNITION of the polyploid nature of various economic plants has become increasingly important, and the type of polyploidy is also of prime importance in the study of phylogeny within any genus or family of plants. Various cytological and genetical criteria of polyploidy have been used, such as chromosome number, the number of nucleoli, polyvalent chromosomes in diakinesis, and tetraploid segregation ratios of genetic characters. In many plant genera, chromosome number together with the number of satellites, secondary constrictions and nucleoli (and where available with additional points in chromosome size and morphology) are sufficient to show the type of polyploidy and in some cases to provide adequate evidence as to how it has arisen[1]. In the genus Brassica, even the ancestral species have thus been clearly recognized in several cases[2].

In some genera, however, the distinction between allo- and autopolyploidy is difficult to make, even when considerable information, both cytological and genetical, is available. Cadman[3] and others have shown that in cultivated potatoes with $2n = 48$ chromosomes the chromosome number is probably tetraploid, but a genetical proof of auto- rather than allotetraploidy is by no means simple, partly owing to crossing-over and what has been called double reduction of the particular genes concerned. Other workers with the potato have regarded it as functionally a diploid, a view which is still not entirely excluded, although the chromosome number is evidently at least tetraploid.

In a recent note, Cadman[4] finds from 2 to 9 multivalent chromosomes in the pollen mother cells of the variety Flourball, the large majority being quadrivalent, with a few of even higher valence. As many as 8 quadrivalents were found in one cell (where 24 bivalents might be expected in a simple allotetraploid), suggesting the presence of 8 chromosomes which are at least partially represented in quadruplicate. The presence of high multivalents has also been shown in potato varieties by other investigators, indicating segmental interchange, which is well known to be of frequent occurrence in plants, such as the potato, which reproduce mainly by vegetative methods.

While this evidence increases the likelihood of autotetraploidy in the potato, it by no means constitutes proof. Studies of the nucleoli and their relation to the satellites have given such clear evidence of allo- or autotetraploidy in many other plant genera that a similar study of nucleoli in the potato is obviously called for. If, following the Feulgen stain, a green dye is used after an alkaline mordant[5], significant results should be obtainable without difficulty.

R. RUGGLES GATES.

Marine Biological Laboratory,
Wood's Hole, Mass.
Aug. 24.

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[1] Gates, R. R., *Bot. Rev.*, 8, 337 (1942).

[2] Sikka, S. M., *Genetics*, 40, 441 (1940).

[3] Cadman, C. H., *J. Genetics*, 44, 33 (1942).

[4] Cadman, C. H., NATURE, 152, 103 (1943).

[5] See Semmens, C. S., and Bhaduri, P. N., *Stain. Tech.*, 14, 1 (1939), and later papers.

Apparent Reversal of Position of the Golgi Element in the Renal Tubule

THE work of Goormaghtigh[1] in elaborating on and extending Ruyter's discovery[2] of specialized cells in the renal arteriole, when taken along with Zimmerman's description[3] of an aggregation of the cells in the adjacent distal tubule, which Zimmerman called the *macula densa*, has introduced new terms and concepts into the histology and pathology of the kidney. It has already been shown that the tubule and the glomerulus which are in such intimate contact at the glomerular root are parts of the one nephron, and that both structures—the arteriole and tubule—seem similarly affected in disease[4]. Because of these facts and since Goormaghtigh has described both tubule and vessels as being jointly affected in several experimental procedures, we had suggested the term *juxta-glomerular complex* to serve as an all-inclusive term for these structures forming the glomerular root.

Apart from the aggregation of nuclei, distinctive features have been lacking for the cells comprising the *macula densa*. Goormaghtigh[1] described the centrosome in the *macula densa* as being situated on the side of the nucleus towards the attached pole of the cell, but other features to suggest a special function have not been described. Studies were undertaken with various techniques for the Golgi element in an attempt to supply this deficiency.

Kittens were killed rapidly with ether, and kidney blocks were prepared by the Da Fano and Mann-Kopsch (Weigl) techniques. In addition, rabbits were killed, each by a single blow on the head, and blocks of kidney tissue were prepared by the Aoyama, Champy post-osmified (Kolatchev) and Mann-Kopsch (Weigl) techniques. In every instance, the osmium preparations were of little use, whereas the silver impregnations (Da Fano and Aoyama) were quite satisfactory. It was found that toning of the sections for five or ten minutes in gold chloride (0·1 per cent containing a few drops of glacial acetic acid per 100 c.c.) appeared to increase the clarity of the images of the Golgi structures.

The appearances of the Golgi structures in the cat and rabbit kidneys are essentially similar. Without enlarging further on the appearance of these structures in the various segments of the renal tubule, suffice it to say that they were seen as granules and short rods. Their position in most tubule cells is remarkably constant, almost invariably being immediately on the lumen side of the nucleus. In the distal tubule a similar position is found except in the cells of the *macula densa*, where the position in respect to the nucleus seems to be reversed and the Golgi element appears to lie on the side of the nucleus towards the attached pole of the cell.

One will not attempt to infer any significance from this apparent reversal of the Golgi element. It may be suggested that if any autonomy existed in the blood supply of the mammalian nephron, the strategic situation for such an effect to be put into action seems to be the juxta-glomerular complex. This autonomy might consist of the regulation of the intermittency of glomerular flow, if such exists, or alteration in the pressure in and about the tubules, or in the afferent and efferent arterioles.

Further studies are in progress on the Golgi element in the kidneys of various other species and will be reported later in detail. It is felt that the cytological aspects of normal and abnormal physiology have been neglected, and that cytological techniques might add something to our information about the normal and diseased human kidney, among other organs.

I am grateful to Dr. John R. Baker of the Department of Zoology and Comparative Anatomy, Oxford, for his advice, encouragement and unfailing help in these studies; and to him and to Prof. E. S. Goodrich, through whose kindness it was possible to confirm some of this work in their department.

J. F. A. MCMANUS.

Royal Canadian Army Medical Corps
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[1] Goormaghtigh, N., (Refs.) *Arch. Biol. Paris*, 51, 293 (1940).

[2] Ruyter, J. N. C., *Z. Zellforsch.*, 2, 242 (1925).

[3] Zimmerman, K. W., *Z. Mikr. Anat. Forsch.*, 32, 176 (1933).

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Competition for Nitrogen between the Take-all Fungus and the Roots of Crop Plants

SURVIVAL of the take-all fungus (*Ophiobolus graminis*) in buried infected cereal stubble is prolonged by an adequate supply of soluble nitrogen from the surrounding soil[1,2]. If the soil is left in clean fallow after harvesting a cereal crop affected by the take-all disease, then the ammonia and nitrate nitrogen set free by the activities of soil micro-organisms will become available to *O. graminis* in the buried infected cereal stubble, and the survival of the fungus is likely to be prolonged. But in soil under crop, much of the nitrogen thus set free will probably be taken up by the plant roots before it can reach *O. graminis*. With this possibility in mind, I have recently compared the survival of *O. graminis* in lots of 250 lengths each 1½ in. long of infected wheat straw buried in fallow soil, and in soil under trefoil, mustard, and oats, respectively. Eight weeks after burial of the infected straws in the soil, the percentage of straws containing viable mycelium of *O. graminis* (as revealed by a wheat seedling test[1]) was 68 under fallow, 18 under trefoil, 17 under mustard and 4 under oats.

Although due allowance must be made for the fact that this experiment was carried out in boxes of soil and not in the open field, it seems safe to conclude that the take-all fungus is likely to disappear more quickly from soil under a non-susceptible crop than from soil kept fallow. This observation may explain the success of a system followed by certain English farmers for continuous barley growing. Barley is susceptible to the take-all disease, and the second or third consecutive barley crop on the same land is sometimes severely attacked. But barley undersown with trefoil (which makes a luxuriant growth in late summer and autumn after the barley has been cut, and is then ploughed in as a preparation for the next barley crop) has not so far been observed to suffer from take-all. To explain this observation, it is suggested that the active growth of the legume after barley harvest keeps the available nitrogen content of the soil at a very low level, with resulting detriment to the longevity of *O. graminis*, most of which is unable to survive until sowing of the new barley crop in the spring.

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[1] Garrett, S. D., *Ann. Appl. Biol.*, 25, 742 (1938).

[2] Garrett, S. D., *Ann. Appl. Biol.*, 27, 199 (1940).

Vacuum Filtration of Sewage Sludge

IT is interesting to know[1] that the results of experiments on the aeration of sewage sludge, as a preliminary to coagulation and vacuum filtration, may shortly be published by the Rivers Department, Manchester.

In Great Britain, the first experiments on vacuum filtration of activated sludge appear to be those carried out at Sheffield sewage works by the late John Haworth[2], and mentioned in a paper published by him in 1923. During the discussion on this paper, it was stated that by further aeration of surplus activated sludge in separate tanks, it is possible to bring it into a condition in which a great deal of water can be drawn off and the sludge can be more easily filter-pressed.

It is unfortunate that the results of subsequent experiments at Sheffield, by Howarth and J. H. Edmondson (his successor), have not been published. The latter has been working on the subject for the past seven years and, in his early experiments, found that activated sludge is most easily filtered when in a nitrifying condition and within three to six hours after leaving the sewage purification plant. In a tentative scheme which Edmondson has prepared, it is intended to store surplus activated sludge in a bio-aeration plant, designed for the dual purposes of aeration and equalizing the flow, previous to vacuum filtration.

J. H. GARNER.
(Chief Inspector.)

West Riding of Yorkshire Rivers Board,
Wakefield.

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[1] NATURE, 153, 249 (1943).

[2] Haworth, J., Proc. Assoc. of Managers of Sewage Disposal Works (1923).

Nutritional Research in the Crown Colonies

PROF. C. M. YONGE[1] refers to the need for the establishment of a centre of marine research in the West Indies, and further, he urges the creation of a fisheries' station there, after the War.

In 1941, I wrote to the *Lancet*, putting forward a similar requirement for nutritional research centres in the Crown Colonies. As yet, they possess no such organizations, as we see, for example, in India (Coonoor) or in China (Henry Lester Institute), to say nothing of the relatively great number of research units in Great Britain. Apart from the very obvious nature and even elementary considerations of such need, the Crown Colonies—with their severe incidence of deficiency disease states out of all parallel to our own country—afford quite exceptional opportunity for sustained nutritional research, as for example, their *different* dietaries, the *different* or apparently different factors which lead up to the same expression in types of disease, in *different* races and peoples. Again we have to remember, also, all nutritional investigation we should undertake in these Colonies primarily affects the welfare of those peoples, not ourselves.

Research institutes not only afford opportunity for research, but they also provide facilities for local training within the country concerned, and they offer security of tenure for the locally trained man. Many Indians, trained at Coonoor, now are not only contributing to the solution of many of their own food problems, as they should be, but also have become well-known authorities in a much wider field. Little of such opportunity has been given to our Crown Colonies, with the comparatively few exceptions of expensively trained home men, and even so, without the full facilities, there has been little enough opportunity for sustained or inclusive research.

Similar research centres, therefore, are long overdue, not only for the West Indies but also for West Africa, East Africa and so forth.

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Corfe View Road, Parkstone,
Dorset.
Aug. 1.

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[1] NATURE, 152, 136 (1943).

James Prescott Joule and the Unit of Energy

PROF. H. S. ALLEN's communication in NATURE of September 25 prompts me to mention a recent conversation which I had with a Manchester man whose evidence I should have considered trustworthy. He mentioned that in his youth he had known a man who had been well acquainted with Joule, and that he had told him that Joule himself always pronounced his name 'Jole', with the first vowel as in 'Joe'.

I should be interested to know whether there is any corroboration of this third possible pronunciation.

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FURTHER to Prof. H. S. Allen's communication in NATURE of September 25, I may say that Joule used to live not far from my home at Sale, near Manchester, and I have often seen his house. His name was pronounced 'Joole', thus confirming Prof. G. W. O. Howe's pronunciation.

GRAHAM RENSHAW.

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RESEARCH ITEMS

Shell Fish-hooks of the Californian Coast

The Bernice P. Bishop Museum Papers for May 1942 include a useful account by Eugene Robinson of the types of shell fish-hooks in use on the Californian coast, and of the method of their manufacture. These hooks from the Santa Barbara Channel are of the circular type familiar in Polynesia and Micronesia, and are made by means of chert drills and stone files from pieces of shell cut to a flat pear-shape. Mr. Robinson explains how the circular hook, which looks so unpromising to a European fisherman, works in practice and is so satisfactory that steel hooks of similar pattern are sold in the stores of Honolulu. There must be no striking with these hooks; the fish hooks itself, and, with a gentle tension on the line, the hook turns over through the thin tissues at the edge of the fish's mouth, securing it more safely than an ordinary steel hook with a barb.

American Anchovies

Samuel F. Hildebrand gives a detailed review of the fishes of the family Engraulidæ in his paper "A Review of the American Anchovies" (Family Engraulidæ) (Bingham Ocean. Collect., Peabody Museum of Natural History, Yale University, *Bull.* 8, Art. 2, 1943). The anchovies are becoming increasingly important economically and, besides being fished commercially for food, are preyed upon by man, fishes and birds, and are also used extensively for bait. The review is very complete and contains descriptions of seventy-seven species and sub-species, nineteen of which are new. Keys are given to all the species in each genus and figures of most of them. They are carnivorous and typically pelagic shore fishes, usually moving about in schools, though sometimes taken singly at depths as great as 20–30 fathoms. Many ascend freshwater streams, especially in South America, where several species are found in the Amazon basin, a few of them in its upper tributaries. The author recognizes only one species apparently common to both Atlantic and Pacific coasts, *Anchoa spinifer*, and thinks it possible that even here specific differences may yet be found. The number of species from the Pacific recognized in these studies is only about two thirds as great as the number from the Atlantic, the chief home of the American Engraulidæ being in tropical and subtropical regions.

New Species of Fish

Henry W. Fowler describes a large number of new fishes from Florida, Eastern Brazil and Hawaii ("Notes on Florida Fishes, with Descriptions of Seven New Species. A Collection of Freshwater Fishes obtained in Eastern Brazil", by Rodolpho von Ihering. The George Vanderbilt Oahu Survey—The Fishes. *Proc. Acad. Nat. Sci. Philadelphia,* 93; 1941). The several collections noted in the first paper contain an interesting tide pool series from Florida made by Baldouin Lucke, showing early stages of development in certain species. The vernacular names are given in most cases in those from eastern Brazil making this paper of special value. In the third paper special attention is paid to colour, from notes made from the freshly received specimens, many of which remained brilliant for a long time. All these contributions are very well illustrated. Dr. Fowler has also published recently a series of short notices on fishes from 1939 until 1941 (Notulæ Naturæ of the Academy of Natural Sciences of Philadelphia).

Oysters of the Western Atlantic

Richard A. McLean attempts to classify the family Ostreidæ (*Notulæ Naturæ,* No. 67; Jan 14, 1941. Academy of Natural Sciences of Philadelphia). T. C. Nelson (1938) has shown that the correlation between the depth of the valve and the position of the muscle scar is of great anatomical importance. In the forms with a relatively deep cavity in the valves and an accompanying posterior position of the adductor muscle there is a water chamber anterior to and running dorsal from the right epibranchial chamber—called by him the promyal chamber. It is open at the top and water is expelled through this channel to the outside in addition to the usual course. The possession of this chamber has a definite survival value, such oysters being able to live in more turbid waters than those without it: moreover, the type of reproduction is different in the two forms, those with the chamber being diœcious and oviparous whilst those without it are hermaphrodite and larviporous. The present author uses these facts for separating two sub-genera of the genus Ostrea when the anatomy and type of reproduction are known. There is only one genus in the family with the subgenera Ostrea s.s., without promyal chamber, and monœcious, incubating the large embryos in the gill lamellæ, and Crassostrea, the type being *Ostrea virginica,* with promyal chamber, and diœcious, discharging the seminal products directly into the water.

Longevity of Paramecium

L. L. Woodruff (*Proc. U.S. Nat. Acad. Sci.,* 29, 135; 1943) reports that about 21,800 generations have taken place in a culture of *Paramecium aurelia* since it was started in 1907. No conjugation has been observed, and it would, therefore, seem that the vitality of these unicellular organisms is preserved without conjugation. The possibility of endomixis, of course, must be considered; nevertheless, the fact that the rate of division and general vitality of the culture has remained constant without cross-fertilization is notable.

Polyploidy and X-ray Dosage

K. Fröier, A. Gustafsson and O. Tedin (*Hereditas,* 29, 145; 1943) show statistically that on wheat and oats the effect of X-rays upon mitosis in dormant seeds differs significantly between diploids, tetraploids and hexaploids. Hexaploids possibly provide a straight-line curve of X-ray dosage, whereas diploids and tetraploids show a sigmoid curve. The authors suggest that it would be wise to re-investigate straight-line proportionality especially at low dosages of X-ray.

Soil Conditions in the Plant Pot

The greater volume of work on soils has been carried out on open ground, and relatively little is known, apart from culture experiments, about the limiting conditions of growth in a plant pot. Two papers by A. G. Pollard and C. W. R. Smith (*J. Roy. Hort. Soc.,* 68, Pts. 7 and 8; July and August 1943) describe some preliminary experiments upon the special conditions in such small units of soil. Levels of the major soil nutrients are higher in the field than in pots, and are higher in pots indoors than when placed in the open. Glasshouse conditions, moreover, produce the greatest ratio of shoot to root. Part of the disappearance of soluble matter from soil in pots is probably due to the action of the earthenware wall, and lime is removed in greater proportion than phosphate and potash. The papers are very suggestive, and some extremely useful results should accrue from a continuance of the investigation.

Granitization of Hornfelsed Sediments

A DETAILED field, petrological and geochemical study of the hornfelsed Silurian sediments enclosed within the Newry granodiorites of Goraghwood Quarry, Co. Armagh, has been made by Doris L. Reynolds (*Proc. Roy. Irish Acad.*, 48, B, No. 11, 231–265 ; 1943). It is established that two major changes are involved in the granitization process. The preliminary change was the metasomatic development of irregular bodies, lenticles, veins, etc., of porphyritic trondhjemite from two varieties of biotite-hornfels ; a change involving the fixation of migratory Na_2O, CaO and SiO_2, with concomitant driving out of other constituents. Migratory MgO and FeO, together with an appropriate amount of K_2O, can be traced in the rims of biotite and cordierite enrichment which are characteristically developed around the granitized bodies. The second major change was the development of porphyroblasts of microcline, and of bodies of granodiorite, adamellite and granite-pegmatite, both from earlier-formed masses of trondhjemite and directly from biotite-hornfels. This change involved the fixation of K_2O, an immediate source for which is found in the migratory K_2O liberated from the hornfelses during the preliminary soda metasomatism. A third variety of metasomatism is the conversion of diopside-hornfels to biotite-hornblende-plagioclase hornfels, which is chemically and mineralogically equivalent to quartz-biotite-diorite. The chemical data indicate that the minimum introductions necessary to initiate the complex geochemical migrations were sodium, calcium and silicon, and that all the other constituents can be adequately accounted for as derivatives from the hornfelses themselves. At the completion of the granitization process at one place the unfixed balance of sodium, calcium and silicon travelled on, to recommence the granitization cycle at fresh loci. Repetition of the process continued until the supply was exhausted. It is concluded that the introduced materials were passing through and/or emanating from the granodiorites at the time of their crystallization. The problem of their ultimate source lies outside the scope of the investigation and remains to be tackled by further work elsewhere.

Polymerization of Hydrogen and Deuterium Fluorides

THE vapour densities of these compounds over a range of temperatures and pressures have been redetermined by R. W. Long, J. H. Hildebrand and W. E. Morrell (*J. Amer. Chem. Soc.*, 65, 182 ; 1943). The highest degree of association found was 4·5, the association factors for deuterium fluoride being appreciably higher at each temperature than those of hydrogen fluoride. A previous proposal by J. H. Simons and J. H. Hildebrand (*J. Amer. Chem. Soc.*, **46**, 2138 ; 1943), although it has not been substantiated by subsequent work, is again considered in relation to the experimental results : it assumes that only hexamers are present in the polymerized product, $6HF = (HF)_6$, and is found to represent the results fairly well, although there is indication of lower polymers at lower degrees of association. This agreement is not regarded as amounting to proof of its sufficiency.

An Analysis of British Meteor Data

J. G. PORTER has published a paper with the above title which reveals the unsatisfactory nature of some of the old methods for computing the real paths of meteors (*Mon. Not. Roy. Astro. Soc.*, **103**, 3 ; 1943). In many cases, more especially in Denning's lists, preconceived opinions were formed regarding the position of the radiant, and the paths recorded by the observers were adjusted to fit in with this. The result was that systematic and accidental errors made by observers were obscured by the non-systematic errors allowed by the computer of the real paths. The value of such a procedure became more obvious when paths were recorded by more than two observers ; in many such cases very drastic adjustments were necessary, and in addition, in many of the doubly observed meteors it is shown that real paths and radiants were computed when there were no accordances at all. It was realized many years ago by the Meteor Section of the British Astronomical Association that the old method, which was still in use, was most unsatisfactory, but it was not until 1936 that an entirely new method was developed by Davidson, and the Computing Section of the British Astronomical Association immediately undertook the reductions under the directions of Porter. It is interesting to notice that of 232 paths published by Denning, where original data were available, it was necessary to reject 60 as being of zero weight, and in 172 of the remainder serious discrepancies between heights, lengths of paths, and speeds, exist when Denning's results are compared with those of Porter. Altogether 1,253 reductions have been made by the new method and results have been published from time to time (*J. Brit. Astro. Assoc.*). In the present paper Table 1 gives multiple accordances from 1892 to 1940, a total of 61, and Table 4 supplies results for the old accordances from 1865 to 1928. A very full discussion of errors is embodied in the paper, and it is shown how Prentice's technique for observation has introduced a considerable improvement in the results. It is hoped that further research will settle finally the vexed question regarding hyperbolic meteors, which British observers are very reluctant to accept.

Cleaning of Mirrors before Aluminizing

A paper with this title by Vladimir Vand (*J. Brit. Astro. Assoc.*, **53**, 7 ; 1943) provides an interesting account of the troubles encountered in the new process of aluminizing mirrors. These are divided into four chief classes : (1) Imperfect cleaning of the mirror. It has been found that a layer of impurities, even if only one molecule thick, between the glass and the coating, affects the coating very seriously. (2) Imperfect vacuum which is sometimes responsible for brown or black deposits. (3) Dirty aluminium and/or tungsten spirals which are responsible for impurities being evaporated on the mirror, and then aluminium is deposited on top of these. (4) The deposit is too thick, and when this occurs a milky deposit sometimes results. The paper deals very fully with these difficulties and with the methods adopted for overcoming them, and those who have had their mirrors aluminized will appreciate, from a perusal of this paper, the enormous amount of care and attention which are necessary if satisfactory results are to be obtained.

THE PLANE TREE

By ALEXANDER L. HOWARD

Travellers from warm and sunny countries criticize, quite rightly, the smoky atmosphere of London. It is a curious but fortunate fact that this damp and smoky climate, which retards the growth of nearly all forest trees, for some unknown reason invigorates the plane (*Platanus orientalis* Linn., *P. occidentalis*, *P. acerifolia* Willd.).

Throughout the City and its suburbs this lovely tree flourishes in all its grandeur and beauty, and completely outclasses other varieties introduced from foreign lands. For example, the acacia cannot live in England up to its national reputation in America, and has utterly failed to fulfil Cobbett's well-known claims.

It would probably be impossible to find a more beautiful avenue of trees than that which leads up the Mall to Buckingham Palace. These trees are now in their youth, and should grow in dignity for at least another two centuries, but already their spreading beauty in summer and their equally imposing winter aspect are unique. Planted and spaced at regular intervals, without failure or exception they have grown to a uniformity in size, both as regards the crown and the trunk. No other tree but the plane could be relied upon for such regularity of growth, and it is partly for this reason that it is so suitable for avenue and roadside planting.

Whilst all Londoners are familiar with its grace and beauty, and grateful for its cool shade in dusty summer heat, it is doubtful whether many realize the history of this interesting foreigner, which has become so happily naturalized in Great Britain. Indeed, such is our national ignorance and lack of education on this important subject, that only a small minority of English people know the difference between a plane and any other forest tree, despite its annual habit of shedding its bark, which is its own original and destructive way of keeping healthy.

Its tenacity and stubborn resistance to violent attack has been exemplified. "A fine plane tree can now be seen flourishing by the side of the Grand Junction Canal in London, close to the North Gate of Regent's Park leading to Avenue Road. It has an interesting history. In 1874 a barge containing petroleum, while passing up the canal, exploded with a report which was heard ten miles away. The bridge and the keeper's cottage were blown away, the plane tree being apparently destroyed. Thirty years after, the only part of the old trunk remaining was a dead, charred, pointed piece, which could be seen protruding through the new and vigorous growth around it; this dead piece has now disappeared (1932), and the only sign of the disaster which remains is an opening extending from the ground to about 10 feet from the present top of the tree. This opening is now closing, and it is safe to predict that in a very few years the trunk will no longer bear any evidence of the damage". This opening is now (1943) scarcely noticeable.

The Times has quoted another instance of what the contributor called "The Dauntless Tree", namely, the plane tree outside Stationers' Hall, which, "in spite of fire and bombs which stripped it of all its leaves and branches, put forth new leaf all up its abnormally straight stem, symbolising the dauntless spirit of London".

An admirable picture was produced in the *Tree Lover*, entitled "Bath after the Blitz", showing five plane trees in the demolished Circus; it now transpires that these trees are much less damaged than was originally thought to be the case.

From earliest times history records examples of the prominent position held in arboriculture by the plane tree, which was introduced first into Greece, and afterwards into Italy, and afterwards throughout all Europe, southern Asia, and in Persia, where the magnificent 'Chenar' trees have been the pride of its people. Continual reference is made to the plane tree before and after the rise of the Roman Empire. About the year A.D. 530 Pliny tells us:

> "But who would not marvel rather at this, that our people here should go into farre countries, and fetch a tree from thence, even out of another world, only for the shade that it giveth. For surely of fruitful trees Italie hath store ynouth. And what tree should that be but the very plane, brought first over the Ionian Sea into the island Djomedea, for to beautifie the tomb of Diomides. From thence translated into Sicilie and so bestowed at length upon Italie; and there planted, as a most regular, rare, and special tree. But now it is caried as far as Tetwin and Tournay in France, where it is counted an appertenance to the very soile that paieth tribute, insomuch, as people will but walke and refresh themselves under the shadow of it, must pay a custom therefore unto the people of Rome. Dionysius, King of Sicile, and the first of that name, caused them to be brought from Rheguim in Calabria to his roiall cittie, where his palace was, onely of a singularitie because they should be seen to give a shade before his house, where afterwards was made the Colledge or a place of public exercise."

and:

> "Of a certaine region we have before written, called Aulocrene, lying in the way between Apamia and Phrygia: and there the paisants of that countrey can show you that very plane tree, on which Marsyas the musician hung himselfe in a melancholly mood, for that he was overmatched in his owne cunning and professed skill, by Apollo: And surely like it is, that even then he made choice of that tree for the bignesse."

Evelyn says:

> "This beautiful and precious tree, originally sacred to Helena . . . was so doated on by Xerxes that Aelian"

and other authors tell us:

> "He made halt and stopped his prodigious army of seventeen hundred thousand soldiers, which even covered the sea, exhausted rivers, and thrust Mount Athos from the Continent, to admire the pulchritude and procerity of one of them; and become so fond of it, that, spoiling both himself, his concubines, and great persons of all their jewels, he covered it with gold, gems, necklaces, scarfs, and bracelets, and infinite riches; in sum, was so enamoured of it, that for some days neither the concernment of his grand expedition, nor interest of honour, nor the necessary motion of his portentious army, could persuade him from it."

Elwes and Henry in "Trees of Great Britain and Ireland" tell us that *Platanus orientalis* was introduced into England some time before 1562; the Western plane *P. occidentalis* in 1636; and distinction was made of the botanical species *P. acerifolia* in 1703. They also enumerate a great number of outstanding examples, including one "planted by Bishop Gunning in the Palace Gardens at Ely in 1896. It was found by the shadow to be about 100 feet high and 23 feet in girth at 3 feet from the ground". At Mottisfont Abbey there is a magnificent tree which Elwes measured in 1898, 29 ft. 8 in. at 4½ ft. from the ground. This tree is remarkable on account of its gnarled growth. He also mentions one at Woolbending Rectory, Sussex, about 105 ft. high by no less than 25 ft. in girth, and directs attention to the triumphant beauty of the avenue at Cowdray Park. They also say:

> "The planes in Berkeley Square are worth notice on account of their uniform burry trunks swelling at the base. . . . They were planted by Mr. Edward Bouverie in 1789 and are probably the oldest plane trees in London. According to Mr. Birkbeck the two largest, in 1906, girthed at 5 feet, 13 feet 10 inches and 13 feet 4 inches respectively, and were about 85 feet high. (The largest of these now measures 14 feet 9 inches in girth and 5 feet 1 inch in diameter at base.)
>
> Tradition says that this was a burial ground during the Plague of London in 1665."

Although these trees grow to a magnificent size in England they do not compare with those of which Pliny writes as follows:

> "and in truth this tree [the plane tree], and the situation thereof, is so admirable, that Licinius Mutianus, thrice Consul and late Lieutenant Generall and Governour of that Province, thought this thing worthie to be regarded as a memoriall to posteritie, when he and 18 *more persons* of his Companie used to dine and sup within the hollownesse of that tree; where the very leaves yeelded of the own sufficient bed and bench room to rest and repose themselves."

Record trees are also quoted in Greece, Constantinople, and Samarkand, where the immense girths of 37 ft. and 39 ft. were attained.

Earl Sandwich in the year 1739 directed attention to

> "the great Plane of the island Stanchio (anciently Cos). . . is remarkable for its size and the care with which the natives have attempted to preserve it. It has stood for time immemorial in the chief town of the island, and while it is the boast of the inhabitants, it is also, and with justice, the wonder of strangers."

He also remarked

> "Among the curiosities of this city is a Sycamore-tree, which is, without doubt, the largest in the known world . . . from the outside verge of which, to the trunk, I measured forty-five large paces."

It is supposed that early botanists mistook the *Acer pseudoplatanus* for the fig-tree, or gave it this name on account of its resemblance. It seems more likely, however, that the tree they saw was the plane tree. That which we call sycamore the Americans more correctly term the great maple. In bark and timber, in flower and seed, there is no resemblance whatever between the *Acer pseudoplatanus* and the *P. orientalis*. According to Sargent, Acer is the classic name of the maple tree, and Platanus is the name of the plane tree. In America all the timber of the Acer species is called maple, and that of the Platanus sycamore. In Scotland the produce of *Acer pseudoplatanus* is called plane. The resulting confusion can easily be understood.

Throughout France and Germany the value of the timber produced by the plane tree has always been recognized. Not only were the trunks of the trees utilized with the utmost economy, but even the limbs have been carefully converted and put to useful purpose for furniture, floorings, and interior decoration. In America, also, its value has been fully realized, and the wood has been quarter sawn, which displays handsome marking, and earned the name of 'lace-wood', by which it is well known to American craftsmen and in their export trade. It is only in England that the wood has been entirely wasted except as fuel.

The original oak panelling, comprising hall, staircase, and doors in a country mansion damaged in the course of the War of 1914–18 was replaced by American 'lace-wood', but while all who saw the woodwork admired it, not even the owner knew its name or origin.

Magnificent fully grown specimens of this particularly graceful tree can be found in abundance scattered throughout England, Scotland, and Wales, and roadside planting has been steadily carried out in all our towns and villages. In other directions, however, unfortunately, for more than a hundred years big-scale planting has been neglected.

SCIENCE AND THE WAR EFFORT

THE meetings on "Science and Victory" arranged by the Association of Scientific Workers in London on July 11, which took place simultaneously with one in Moscow, well emphasize the critical importance of science in the war effort of both nations and the determination of scientific workers to see that the fullest possible use is made of the scientific resources available. Copies of the addresses given have been made available by the Association.

Sir Robert Watson-Watt in his chairman's address put the essential point squarely enough: no military operation to-day can be a sustained success without applied science. Important and essential as are the other factors, without science they are not enough. Moreover, as other speakers pointed out, it is not merely the part of science in production, in the manufacture of munitions of all kinds and in the development of new weapons and of instruments of ever greater precision that is vital: a new scientific function—that of operational research—has emerged in Britain and in the United States, and in Soviet Russia appears to have existed before the outbreak of war.

Prof. J. D. Bernal's picture of these developments is highly suggestive. Operational research is no longer limited to the technical performance of weapons in the field under the supervision of those competent to assess performance and suggest effective improvements. Strategy as well as tactics has come under scientific surveillance on the field of battle itself. The processes of warfare itself, the effectiveness of various forms of attack and defence are being studied by specially trained men of science, and the results are being analysed and translated into improved tactical methods and weapons. In all this, Soviet Russia appears to have been a pioneer, though both countries are now using men of science for similar extended functions.

In Great Britain, at the present time, as Prof. Bernal suggests, the novelty of the military and operational use of scientific workers is attracting more attention and overshadowing some of the equally important achievements of science, no less vital to our war effort; in the fields of agriculture, nutrition and food supply, and health, it has provided substitutes for essential commodities of which we have been deprived or restricted by the War, especially in the Far East. The post-war consequences of these developments may well be highly important. It was natural for a meeting of scientific workers to look to establishing closer and more direct contact with Soviet scientific workers engaged with us in a common struggle, as has been done already with the United States, and to hope for similar collaboration in building up a new world in which science will at least be free to devote itself wholeheartedly to the service of humanity. Scientific liaison with the U.S.S.R. may well be an important aid to mutual understanding between the two nations, for if we have much to learn of the Soviet effort it is at least equally true that they have much to learn of Britain.

Prof. Bernal's review of these developments suggests, however, that an even more important post-war consequence may be a much greater general awareness of the importance of science: not merely an appreciation of its achievements but a greater desire to understand its method and possibilities. Mr. J. G. Crowther touched on this educational aspect, more particularly in respect of the opportunities in the munitions industry, in an address which referred to some points made at the British Association Conference last March on "Science and the Citizen" with regard to ways and means of increasing the public understanding and appreciation of science. None the less, the significance of the educational opportunities which the increased operational contacts with science in the Forces and the greater use of scientific instruments and weapons by fighting men themselves offer in respect of the post-war world, scarcely appears to be appreciated. If that opportunity is seized, if every possible means is used, whether now through such means as the Army Education Corps or through the Workers Educational Association and other instruments of adult education after the War, to bring home to the ordinary citizen not merely the achievements but also the nature of science and the limitations as well as the possibilities of the scientific method, we shall have taken a long step towards making it possible for society to enjoy the abundance which science has put within our power.

That achievement depends on the use of science, and our scientific resources for science—like planning—has its dangers and limitations, and Britain and Soviet Russia have much to learn from their widely different experiences. We cannot make full and wise use of science in a democracy without a widespread understanding of what science is, what it can do and what it cannot do, and in this respect it may well be that Britain lags somewhat behind Soviet Russia. What may fairly be open to doubt is, as Prof. Polanyi showed in a recent paper, whether Soviet Russia has always understood the true nature and limitation of the scientific method. Science and politics may be consorts but they are ill-mixers, and science and propaganda go ill together. Quality, not quantity, is the vital element in science.

The eloquent plea for co-operation and mutual understanding between science and government, statesmen and men of science, which was uttered by Mr. J. G. Crowther at the meeting emphasizes a further point which lies behind the effort of Soviet and British scientific workers in the struggle with Germany. Whatever the imperfections or neglect of science in Britain and in Russia, both countries are to-day struggling against a power which has struck at the well-springs of scientific thought and advance. As a cable from the Moscow meeting addressed to the Association stated, the Nazis have set themselves deliberately to extinguish the torch of knowledge. Their regime threatens the very existence of scientific life and thought, and while that threat remains there can be no security for the free spirit of inquiry, the patient, independent investigation and creative thought which are the essence of science and the secret of its advance. That challenge has been taken up wholeheartedly by British and by Soviet scientific workers, and the meetings in Moscow and in London on July 11 attest their sincerity and determination. Scientific workers, in addressing themselves to their wider tasks and in accepting wholeheartedly their social responsibilities, must remember also that it is their prime responsibility to guard and cherish that unfaltering quest for truth which is at the heart of science, and to make sure that in all their organization and planning they consent to nothing that impairs their freedom of inquiry or utterance and the ultimate but fundamental loyalty to truth.

CLINICAL PHOTOGRAPHY

AT a meeting of the Association for Scientific Photography held on September 18 at Middlesex Hospital, Dr. H. Mandiwall stressed the particular qualities required in clinical photography. In his opinion these are: (*a*) a simple straightforward record with perfect definition; (*b*) a self-explanatory picture, but nevertheless one which does not include unessential portions; (*c*) a well-presented print, as much care being taken in the mounting and finishing as in a studio portrait; (*d*) in the case of colour photographs, the colour must be true to the original. This is of particular importance in skin diseases which are characterized by the colours of the part affected. It was suggested that a Clinical Group should be formed in the Association, which would discuss the special aspects of this work, and compare technique.

Another point was the collaboration between photographers and manufacturers of apparatus. The requirements of clinical photography are in many cases distinct from those of studio or outdoor work, and it would be of great advantage to have certain apparatus specifically designed for the work.

In opening the meeting, Mr. T. Pomfret Kilner stressed the importance of standardization in technique, particularly in his own sphere of plastic surgery. The photographs taken before and after treatment must be strictly comparable as regards type of film, exposure, lighting, etc. He illustrated his remarks with views of a simple equipment employing a Leica camera and photoflood lighting which enables photographs to be taken at any angle and can also be used for copying radiographs or documents. He recommended that Ortho materials be used for the majority of work; previous to the War, he had always used Agfa Isochrom film.

Miss Hilda Marsden showed examples of the work done in clinical photography at the Christie Hospital, Manchester, using a half-plate camera with studio technique. She laid special stress on the importance of lighting, particularly in delineating the outlines of growths, etc.

In the discussion which followed the papers, Mr. J. E. Andrews showed illustrations of a convenient set-up for photographing patients in bed which was made with the aid of a pair of steps such as is always available in a hospital. The camera was fitted to the top of the steps with the usual ball-and-socket joint and could be directed in any required position. By means of interchangeable lenses and lights also fitted to the top of the steps at varying angles, he was able to take a variety of photographs of a patient from head only to full-length. He had found that a 4½-in. lens was adequate for full-length and an 8-in. for head and shoulders. A 14-in. lens gives a close-up of an individual part with the patient lying flat about 5 ft. below the camera.

As a matter of interest, Mr. Andrews showed a photograph of a patient with one brown eye and one blue, taken with orthochromatic film without a filter. Only one photoflood lamp was used, and the colour rendering was excellent.

Mr. K. Hennell (Metal Box Co.) said that he had taken several thousand clinical photographs during the War in colour, and used Sashalite bulbs exclusively for illumination. He considered this was the best method for tackling a variety of jobs and agreed with Mr. Kilner concerning the necessity for standardization. He exhibited several samples of colour prints on paper.

It was in the discussion generally agreed that clinical photography should be undertaken by a professional photographer who would find it advantageous to make a special study of physiology and anatomy. It was not considered reasonable to expect a medical man or surgeon to do his own routine photography, and it was also pointed out that the majority of hospitals, while equipped for X-ray work, are not well equipped for clinical photography.

Those interested in the formation of a Clinical Photography Section should write to the secretary of the Association, Mr. R. M. Weston, at Houndwood, Farley, Nr. Salisbury, Wilts.

REHABILITATION OF THE 'SCORCHED EARTH' IN THE U.S.S.R.

THE preliminary arrangements have recently been announced by the Soviet Government for the rehabilitation of the different regions of the U.S.S.R. as they are liberated from the Germans. A Commission has been set up representing forestry, timber supply and other interests to arrange for the erection of buildings on the collective farms and of dwellings for the workers. Use is to be made of local supplies of brick or artificial stone of various kinds, and of houses prefabricated in factories: the standard is to be a flat for four families, and thirteen factories are to be put into operation with a capacity of eighty flats per month. The Agricultural Bank will allow 10,000 roubles credit to each family for a period of seven years.

Railways also are to be restored, and dwellings for the staff and the various establishment shops and buildings are to be erected.

Such live-stock as were driven eastwards are to be restored, and regulations have been drawn up for the movement of specified numbers of the animals from seventeen of the reception areas to collective farms in specified regions including Orel, Smolensk, Voronezh, Stalingrad, Rostov, and Stavropol: impressive totals are involved, including 206,000 cattle, 342,000 sheep and goats and 53,000 horses, though these represent only a fraction of the peace-time numbers of animals in these regions. Collection of the animals at specified points in the reception areas was to be completed by September 1, and they were to reach their destination between October 1 and 15. The difficulties will be considerable, but the routes have been worked out: the journey for the animals is in some cases 800 miles. Arrangements have been made for feeding and watering the animals during their journey and for checking the numbers and duly accounting for their arrival. The risk of carrying disease will be very great, but fifty veterinary surgeons (1 for each 12,000 animals) and a hundred assistants are to be seconded from the reserve of the Red Army and distributed along the routes. In order to ensure further attention when the animals reach their destination, schools are to be set up in each liberated province giving veterinary courses varying in duration from three to twelve months. The Agricultural Publishing House is to be given 50 tons of paper for the printing of instructional literature. Other decrees deal with the provision, payment and transport of the drovers.

Collective farms are being recommended to keep all male calves of 1942 and 1943 to become working oxen.

In the case of poultry, it was necessary to establish incubator and poultry-breeding stations sufficient to deal with 16 million eggs: the aircraft industry was instructed to supply the thermostats and thermometers. The number of specialists required will be considerable: 130 are to be detailed for the new stations, but this number will not suffice, and it is proposed to start courses for training a further 580. In order to ease the work of the collective farms as they are re-established, considerable exemptions during the first year are permitted from the deliveries required to be made by the farm to the State; these apply to farms that have suffered from enemy occupation and households that have suffered bereavement or in which the able-bodied members belong to a specified group of experts. Tractor maintenance and repair stations are to be set up, and schedules are issued of spare parts, etc., that must be stocked.

Special provision is made for supplying railway workers with allotments of about one-third acre on which they may grow what crops they like. These plots are to be exempt from compulsory deliveries to the State: they are to be supplied with seeds, pigs and chickens. Provision is also to be made for the education of orphans and children of Red Army men and partisans; there are to be nine 'Suvorov' military schools, somewhat like the old cadet schools, each for about five hundred boys; and twelve 'industrial' schools for boys from the age of ten and for girls from the age of eleven. Co-education is not adopted in these new schools. Houses for 16,300 children are to be set up.

LIGHTNING PROTECTION OF BURIED CABLE

FOR the new toll facilities now being installed in the United States, much of the cable is laid underground to secure greater immunity from effects of sleet, snow, and storms. Burying the cable alone is not necessarily sufficient to free it from the effects of lightning damage. Moreover, when lightning damage such as fusing of cable pairs or holes in the sheath does occur, it is not so easy to locate and repair as on aerial cables since excavations may have to be made at a number of points. As a result of this situation, studies have been made of the factors affecting damage of buried cables by lightning, and the remedial measures which have been devised to provide substantial protection in most cases that are encountered are described in an article by E. D. Sunde (*Bell Lab. Rec.*, **21**, No. 9 ; May 1943).

When lightning strikes, the current spreads in all directions from the point where it enters the earth, and if a cable is in the vicinity it will provide a low-resistance path so that much of the current will flow to the cable and in both directions along its sheath to remote points. The flow of current in the earth between the lightning channel and the cable may give rise to such a large voltage drop that the breakdown voltage of the soil is exceeded, particularly when the earth resistivity is high. The lightning stroke will then arc directly to the cable from the point where it enters the earth, often at the base of a tree. When this happens practically all the current reaches the cable sheath. Furrows so long as 100 ft. have been found in the earth along the path of such arcs.

The current entering the sheath near the stroke point is attenuated as it flows toward remote points. The current leaving the sheath must flow through the adjacent soil, and the amount of this leakage current per unit length of cable is therefore smaller if the soil resistivity is high than if it is low ; thus the current will travel farther the larger the earth resistivity. The flow of current along the sheath produces a voltage between the sheath and the core conductors, which is largest at the stroke point. This voltage is substantially equal to the resistance drop in the sheath between the stroke point and a point which is sufficiently remote so that the sheath current is negligible. Since the higher the earth resistivity, the farther will the current travel, this resistance drop will also increase with the earth resistivity. The maximum voltage between sheath and core is thus proportional to the sheath resistance and also to the square root of the earth resistivity. Carrier cables now being used are of smaller size and have a higher sheath resistance than full-size voice-frequency cables, and for this reason they are more subject to lightning damage, particularly when the earth resistivity is high.

Tests were made on the Stevens Point-Minneapolis cable, using a surge generator which generates a short-time surge of current similar to that of a lightning discharge but of much smaller magnitude. An earth was established remote from the cable, and the surge generator was connected between this earth and the cable sheath, and between the remote earth and earths at distances of 10, 25, and 100 ft. from the cable. Results of the tests are given in the article.

When the voltage at the point where current enters the sheath is great enough to break down the insulation, the conductors and sheath are brought to essentially the same potential by the arcing. Under these conditions, the voltage between conductors and sheath increases with distance along the cable. A maximum is reached at some distance from the original fault, and beyond this point the voltage slowly decreases. After a puncture of the insulation where the current enters the sheath, other failures may therefore occur at some distance from this point in either or both directions. A single lightning stroke may thus cause insulation failures over a considerable distance along the cable.

One method of reducing failures caused by lightning strokes to buried cables is to increase the core insulation. This has been done for most new installations of buried cable. The cable itself, and such accessories as cable terminals and stubs, loading pots, and gas-alarm contactors are all provided with sufficient extra insulation to double the dielectric strength between cable conductors and sheath. For a cable like the one on which measurements were made, such increased insulation would reduce the number of lightning strokes that could cause failure by direct arcing to the sheath to about 15 per cent of the total instead of 50 per cent, and would almost entirely eliminate the danger of breakdown when lightning strikes the earth as much as one hundred feet from the cable. Another method, which may be employed in addition to the extra insulation where excessive lightning damage would otherwise be expected, is to bury shield wires over the cable. These conduct away part of the lightning current and thus reduce the amount that flows along the sheath. These wires may be ploughed in with the cable, or they may be installed afterward. The percentage of the current carried by the wires depends to a greater extent on their inductance relative to that of the sheath than on their resistance. Two wires are employed in order to obtain a lower inductance than would be possible with a single wire.

On the route between Stevens Point and Minneapolis where the shield wires were installed after the cable was in place, two 165-mil copper wires about 12 in. apart were ploughed in some 10 in. above the cable for a distance of 80 miles. Surge measurements made after these wires were installed indicated that the wires reduced the voltage between sheath and core conductors by about 60 per cent, which is in substantial agreement with theoretical expectations. The shield wires should thus reduce the number of direct lightning strokes that would be expected to cause failure to about 10 per cent, instead of 50 per cent without shield wires.

PLANT DISEASES

SEVERAL papers concerning plant diseases appear in a recent number of the *Transactions of the British Mycological Society* (26, Pts. 1 and 2 ; April 1943). Measurement of the intensity of plant disease in the field has occupied the attention of a sub-committee of the Society's plant pathology committee. The results indicate some rather suggestive lines of attack in the investigation of several diseases. A graph showing the incidence of potato blight at the Seale Hayne Agricultural College for different years, and for other localities for 1941, is very illuminating. The quick rise to a high degree of infection in 1932 is in marked contrast to the slow development of the disease in 1937, and merits further investigation. Other results are quite as suggestive. The sub-committee's main contribution, however, is in the standardization of methods, details of which are given in the paper.

W. C. Moore continues his series of descriptions of new and interesting plant pathogens. A disease of maize seedlings raised in nutrient solution was found to be caused by *Fusarium moniliforme*. It could be eliminated from the grain by soaking and heating to 54° C. for 20 min. A species of Penicillium, probably *P. hirsutum*, has also been assigned as the cause of a rot of Scilla bulbs, and *Helminthosporium Allii* is the pathogen of a bulb canker of garlic. This disease was discovered in an imported consignment before it could be planted, and so should not establish itself here. A brief note by H. Duerden announces the appearance of *Pythium mamillatum* in England. It produces a damping-off disease of cress, similar to that caused by *P. deBaryanum*. Elizabeth Blackwell gives details of the very complex life-history of *Phytophthora cactorum*, a species with pathogenicity upon such widely differing genera as Cereus, Acer, Pyrus, Pæonia, Rheum, Fagus, Pinus and others. The species is paragynous and homothallic, and considerable progress in control of this parasite should result from this careful analysis of the many stages of its life-cycle.

In the realm of bacterial plant pathogens, W. J. Dowson publishes a list of species, with synonyms, which should be included in the genera Pseudomonas, Xanthomonas and Bacterium. This should be useful as it is difficult for the general pathologist to follow all the changes in modern bacterial nomenclature.

FORTHCOMING EVENTS

Saturday, October 9

Sheffield Metallurgical Association (joint meeting with the Microchemical Section of the Society of Public Analysts and the South Yorkshire Section of the Royal Institute of Chemistry) (in the Department of Applied Science, The University, St. George's Square, Sheffield), at 2.30 p.m.—Symposium on "Microchemical Analysis".

Tuesday, October 12

Society of Chemical Industry (Chemical Engineering Group and London Section) and the Institution of Chemical Engineers (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 2.30 p.m.—The Rt. Hon. Lord McGowan: "The Future of the Chemical Industry".

Royal Society of Medicine (at 1 Wimpole Street, London, W.1), at 5 p.m.—Dr. W. Norwood East: "The State, the Criminal and the Psychiatrist".

Chemical Society (Leeds Area Local Section) (in the Chemistry Lecture Theatre, The University, Leeds), at 6.30 p.m.—Dr. E. H. Farmer: "Autoxidation in Relation to Olefinic Structure".

Thursday, October 14

Institute of Fuel (at the Connaught Rooms, Great Queen Street, London, W.C.2), at 2.30 p.m.—Dr. E. S. Grumell: Melchett Lecture.

Friday, October 15

Physical Society (at the Royal Institution, Albemarle Street, Piccadilly, London, W.1), at 4.30 p.m.—The Rt. Hon. Lord Rayleigh, F.R.S: "Optical Topics, in part connected with Charles Parsons" (Eighth Parsons Memorial Lecture).

Royal Society of Medicine (at 1 Wimpole Street, London, W.1), at 4.45 p.m.—Dr. N. S. Finzi: "Impending New Developments in Radiotherapy".

Saturday, October 16

Institute of Physics (X-Ray Analysis Group) (joint meeting with the Manchester and District Branch) (in the Physics Department, The University, Oxford Road, Manchester), at 2.30 p.m.—Sir Lawrence Bragg, F.R.S.: "The Physical Optics of X-Ray Analysis": Short Papers and Exhibition of Apparatus, etc., relating to Industrial Problems.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Teacher of Chemistry for Junior Work in Technical Day School and Industrial and Intermediate B.Sc. Classes in the Technical College, a Teacher of Mathematics for Junior Work in Technical Day School and Technical and Intermediate B.Sc. Mathematics in the Technical College, and a Teacher of Mechanical Engineering Subjects up to Higher National Certificate standards, in the West Hartlepool Technical College—The Chief Education Officer, Education Offices, Park Road, West Hartlepool (October 14).

Teacher of Mathematics and Physics in the Junior Technical School and Senior Part-time Classes in the Batley Technical College—The Director of Education, Education Offices, Batley, Yorks. (October 15).

Advisory Officer in Plant Pathology—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (October 15).

Director of Robert Gordon's Technical College—The Secretary, Robert Gordon's Technical College, Aberdeen (October 16).

Borough Electrical Engineer—The Town Clerk, Council Offices, Kettering (October 22).

Professor of Engineering—The Registrar, University College, Singleton Park, Swansea (November 20).

Lecturer in Educational Psychology and Teaching Method—The Principal, Gipsy Hill Training College for Teachers of Young Children, at Bankfield, Bingley, Yorks.

Technical Assistant in a Government Department in London for work connected with the planning of production of X-Ray Equipment—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Section D.562, Alexandra House, Kingsway, London, W.C.2.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Medical Research Council: Industrial Health Research Board. Emergency Report No. 4: A Study of Absenteeism among Women. By Dr. S. Wyatt, R. Marriott and D. E. R. Hughes. Pp. 12. (London: H.M. Stationery Office.) 2*d.* net. [318

Industrial Research: What it Means to British Industry. By Sir Harold Hartley. Pp. 16. (London: Federation of British Industries.) [29

City and Guilds of London Institute. Report of the Council to the Members of the Institute for the Year 1942. Pp. lviii. (London: Gresham College.) [39

Proceedings of the Royal Irish Academy. Vol. 49, Section B, No. 9: Salmon of the River Shannon. By Arthur E. J. Went. Pp. 151–176. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 1*s.* 6*d.* [39

Annual Reports on the Progress of Chemistry for 1942. Vol. 39. Pp. xxviii+257. (London: Chemical Society.) 15*s.* [69

Henley Student Manual. Pp. 28. (London: W. T. Henley's Telegraph Works Co., Ltd.) [89

British Association for the Advancement of Science: Committe on Post-War University Education. Report on University Entranc Scholarships in England and Wales. Pp. 8. (London: British Association.) 6*d.* [99

Board of Education. The Youth Service After the War: a Repor of the Youth Advisory Council appointed by the President of th Board of Education in 1942 to advise him in questions relating to th Youth Service in England. Pp. 32. (London: H.M. Stationery Office.) 6*d.* net. [169

The White Paper on Educational Reconstruction and its Impac on Training for Mechanical Engineering. Pp. 8. (London: Institutio of Mechanical Engineers.) [16

Handbook of the Scientific Instrument Manufacturers' Associatio of Great Britain, Ltd. Pp. 48+53. (London: Scientific Instrumen Manufacturers' Association of Great Britain, Ltd.) [20

The Liverpool and Stoke-on-Trent Railway Hour Section and als Birmingham and Nottingham Hour Sections to speed up Railways i the Midlands. By J. F. Pownall. Pp. 12. (Birmingham: Cottere and Co.) 1*s.* [20

Ministry of Agriculture and Fisheries. Growmore Bulletin No. 9 Orchard Spraying for Commercial Growers. By J. Turnbull. Pp 14+2 plates. (London: H.M. Stationery Office.) 4*d.* net. [21

Other Countries

U.S. Department of the Interior: Geological Survey. Water Supply Paper 873: Surface Water Supply of the United States, 1939 Part 3: Ohio River Basin. Pp. xi+578+1 plate. 65 cents. Water Supply Paper 875: Surface Water Supply of the United States, 1939 Part 5: Hudson Bay and Upper Mississippi River Basins. Pp. xi+406+1 plate. 50 cents. Water-Supply Paper 880: Surface Wate Supply of the United States, 1939. Part 10: The Great Basin. P vi+160+2 plates. 25 cents. Water-Supply Paper 900: Surfac Water Supply of the United States, 1940. Part 10: The Great Basi Pp. iv+126+1 plate. 20 cents. Water-Supply Paper 901: Surfac Water Supply of the United States, 1940. Part 11: Pacific Slop Basins in California. Pp. viii+378+2 plates. 50 cents. Water Supply Paper 902: Surface Water Supply of the United States, 194 Part 12: Pacific Slope Basins in Washington and Upper Columb River Basin. Pp. v+210+1 plate. 30 cents. Water-Supply Pap 903: Surface Water Supply of the United States, 1940. Part 13 Snake River Basin. Pp. vi+246+1 plate. 35 cents. Water-Supp Paper 904: Surface Water Supply of the United States, 1940. Pa 14: Pacific Slope Basins in Oregon and Lower Columbia River Basi Pp. v+208+1 plate. 30 cents. Water-Supply Paper 910: Wat Levels and Artesian Pressure in Observation Wells in the Unit States in 1940. Part 5: Northwestern States. By O. E. Meinze L. K. Wenzel, and others. Pp. iii+184. 25 cents. (Washington, D.C. Government Printing Office.) [12

War Department. Technical Manual TM. 10–420: Emergen Food Plants and Poisonous Plants of the Islands of the Pacific. Dr. E. D. Merrill. Pp. v+149. (Washington, D.C.: Governme Printing Office.) [1

Archæological Reconnaissance in Campeche, Quintana Rao, a Peten. By Karl Ruppert and John H. Denison, Jr. (Publicati 543.) Pp. vii+230+75 plates. (Washington, D.C.: Carnegie I stitution.) 4.25 dollars. [1

Bulletin of the Bingham Oceanographic Collection, Peabo Museum of Natural History. Vol. 8, Art. 4: Physiological Aspe of Spring Diatom Flowerings. By Gordon A. Riley. Pp. 54. (Ne Haven, Conn.: Yale University.) [1

Proceedings of the United States National Museum. Vol. 93, N 3164: The Birds of Southern Veracruz, Mexico. By Alexander W more. Pp. 215–340. (Washington, D.C.: Government Print Office.) [2

PHYSICS Dept
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EDUCATIONAL RECONSTRUCTION (2)

Access to the Universities

SECTIONS VIII and IX of the White Paper on Educational Reconstruction deal with access to the universities and the recruitment and training of teachers respectively.

The common thread woven into each of these two sections is insistence on the quality of the human material which is involved. There can be no argument with the statements that "high ability [should not be] handicapped by the accidents of place of residence or lack of means in securing a university education" and that there will be required "a larger number of teachers of the right calibre", and there emerges, perhaps for the first time in proposals for educational legislation, a true and active appreciation of the worth of the job of teachers, and the necessity for a unified scheme for selecting and nurturing men and women for the teaching profession. Tribute is paid in the assertion that "it depends almost entirely upon the quality of those who staff the schools whether the reforms proposed will . . . , in practice, work out as real educational reforms". As we emphasized in the previous article (NATURE, October 9, p. 393), the child must be the true and only centre of education; nevertheless we must see to it that the teacher is trained in the best and fullest manner in order to qualify for the very important tasks before him.

Dangers lie in the administrative problems involved; a mere expansion of the numbers attending universities can be no solution of the problem of quality; machinery must be devised and tested over a period of years to ensure that only those of high ability or of outstanding personality, or a balanced combination of the two, secure places in our universities and university colleges, and that the delightful but uneconomic student who has in the past spent five and even ten years sampling the several faculties of a university (or even several universities) is no longer able to do so. The selection of university men and women is not easy, and it is by no means certain that we have evolved a satisfactory technique in the present scholarship examination system.

Changes are foreshadowed by the recommendations in the Norwood Report, which embody the idea of a school record carrying at least equal weight with formal examination as a test of fitness to profit by university education, and though much experiment will be necessary, there is here the basis for more equitable selection of those who are not academically brilliant, but who possess sterling character and have been brought up in homes where the very fact of being at home has been an education. Such men and women must not be lost to the universities. In the past many of them have not had access to universities because of the financial position of their parents, and might, on a stringent test of academic fitness alone, be ruled out absolutely.

Under the Government scheme of further education and training an influx of men and women whose further education has been prevented or interrupted by war service will do much for the social and communal life of the universities, which have recently suffered from a reduction in the average age of entry and length of stay of students, with the result that university staffs have rightly complained that many of their students are unable to profit by university methods of teaching, and need more guidance than the already hard-pressed tutor is capable of giving. The White Paper generously looks forward with confidence to the large demands upon the administrative and teaching staffs which will be made by this scheme, and it seems probable that the four-term year which has perforce been instituted in many universities will need to continue, for a time at least, in order to meet the needs of the scheme, even at some sacrifice of the invaluable leisure time which has been lost to war-time students.

Recruitment and Training of Teachers

Greater problems, both legislative and administrative, lie in the proposals for reform in the recruitment and training of teachers. Both recruitment and training are so much and so obviously in need of reform that much has been published on the subject, in almost every type of journal: so much that it can confidently be asserted that the McNair Committee, whose report is awaited with interest, will achieve a miracle if it makes any proposals which can be regarded as original.

The implication that systematic provision should be made for boys and girls to continue their education after senior school age, and afterwards prepare for the teaching profession "if at, say, 15 years of age they express a desire to do so", is dependent for its successful working on a very generous scale of financial assistance, and absolute freedom for the individual to contract out of teaching if he wishes. This means recognition that the training of a teacher up to almost any stage before his active employment in a school is a worth-while investment for the country, even if he never enters the teaching profession, and the complete abandonment of the present system whereby secondary school boys and girls may be tied by agreement to teach after their further education and training at the expense of the State in university or college. Too often the present scheme of Board of Education grants is used as a means to the end of getting a 'college education' for the academically sound student who may be temperamentally quite unsuited to teach, and under whom the next generation of pupils must suffer; nor may the discovery of temperamental unsuitability be made until the fourth year at a university. It is very satisfactory that the White Paper records the fact that "War has revealed that the ability and the character required of teachers is not to be found exclusively in the boys and girls in the grammar schools". Too little respect has been paid to the very great value of the work of men and women in the Armed Forces who have, often for the first time, found themselves called upon to be teachers—teachers not only of matters military but also of current affairs and citizenship, as in the Army Education Directorate's A.B.C.A. and British Way and Purpose schemes—and exemplars of the virtues of courage, constancy and good-fellowship which are none the less virtues of the teacher than of the sailor, the soldier and the airman.

The introduction into the teaching service of men and women who have served in the Forces or in industry will provide a nucleus of teachers who "have had experience of life other than as students and teachers". The narrow circle of school, training college and school must be broken down whatever the cost in administrative labour and cash. In this connexion any plans for a period of public service between leaving school and entering the training colleges or universities will be welcome, as a start in the right direction. Thereafter, exchange between schools, industry and commerce, and public service must be facilitated by every possible means. Great goodwill will be necessary, and recognition by industry, for example, on one hand, that teachers can serve them usefully in employment, and education authorities, on the other hand, that recruits from industry are valuable. Linking the two are those whose talents lie in youth service and adult education respectively.

Much has been done to break down the narrow traditions of the 'two-year' training colleges, which have in the past been responsible for cramping the natural initiative and love of adventure of their students. In this respect the denominational colleges have been the greatest sinners, and in fact are still not free from blame; they have seldom shown the virility of the 'municipal' training colleges. How is it to be ensured that they are more broad in their outlook than heretofore? As mentioned above, a period of public service would do much to ensure that the entrants to such colleges themselves demand a broad and liberal training. The development of the training colleges' association with the universities must provide the basis for a happier state of affairs. Such association already exists in the joint committees of training colleges and universities which are centred in most of the 'provincial' universities. These joint committees, although substantially similar in constitution, having university and training college representatives, vary considerably in their nature, since in certain cases both university and training college representatives are also members of the local education authorities of the area in which university and training colleges are situated. A committee so constituted cannot be expected to favour the full partnership which denominational colleges must be encouraged to enter. It is to be hoped that the McNair Committee will favour the reconstitution of joint committees to include persons of standing, perhaps co-opted, whose main interest is the furtherance of the view that training teachers is *one* problem, and that the university interest is merged with that of the training colleges to the advantage of both. Perhaps the day is not far off when student teachers will receive all their training—academic and professional—within the universities themselves, thus giving them a broader outlook by working in collaboration with students of other callings.

EDUCATION AND RESEARCH IN AERONAUTICS

THERE have been many happenings lately that have tended to focus attention upon the subject the facilities that should be provided in the post-ar future to obtain training for the various branches the profession of aeronautics. The applied side of is science, the design, construction, and maintence of both fighting service and civil aircraft and gines, the handling of air transport services, and e host of auxiliaries called into being by these, will ed a great deal of pioneer work, based on original inking, for its organization. The advances in the chnical outlook made during this War, together th the problems inseparable from the great increase the size of the industry, compared with its pre-war nensions, bring into much prominence the question training the personnel for the profession.

Many facets of this problem are purely educational d are thus inevitably bound up with the proposals the reform of the educational system of Great itain, as foreshadowed by the White Paper on ducational Reconstruction" presented to Parliant by the President of the Board of Education, d the Norwood Committee's report on "Curriculum l Examinations in Secondary Schools". Follow- this there are aspects that are general to all those nches of applied science that for convenience can called engineering. The Institutions of Civil gineers, Mechanical Engineers, and the Institute Physics have each issued memoranda upon these. llowing this, the particular side of the subject that aeronautical was the subject of a discussion at etings of the Royal Aeronautical Society, a report n which is to be published in due course. The th report of the Select Committee on National penditure, on aircraft production, also throws uable light upon the requirements in technical sonnel of the aircraft industry as a whole, and nments upon the inadequacy of the supply at sent.

The subject of professional education in aeronautics eculiar in that it is of more recent birth than most the other professions, and consequently is in a te of immaturity. Most of those intimately conted with it consider that it is suffering from malrition, a view supported by the Select Committee's ort. The possible remedies are of three kinds. expansion of the present system, the same expann with the addition of teaching covering what e consider to be gaps in the existing scheme, or a plete and radical change in the method of apach. Of these the second is the most generally oured—indeed it appears to be the only one sible. The first is admitted, by experience, to be ufficient, and the last, for fundamental reasons, is possible in any educational scheme. Within these ndaries there are two outlooks, training in scien- and technical work, and craftsmanship. These cannot be separated entirely; indeed, it is from craftsman that some classes of technical men uld be recruited.

During the period between the two world wars, steady if not spectacular progress was made in the organizing of training in aeronautics in Great Britain. The many authorities concerned have worked together, and consequently there is functioning to-day a properly co-ordinated scheme that caters for all types of trainees, and is inter-related sufficiently to allow an ambitious candidate to climb the technical ladder to the highest rung if he is mentally capable of doing it. Financially, the position is not yet good. There are a few scholarships devoted specifically to aeronautical training, and many firms in the industry have schemes for helping their apprentices in this respect. The cost of obtaining a part-time training in the technical side of the work, being mostly in the hands of the rate-aided local technical institutions, is not prohibitive to the average apprentice. Under the present war conditions, a small proportion of the State bursaries have been awarded for the study of aeronautical engineering, and the Royal Air Force has a scheme for allowing certain selected technical personnel to study aeronautics, following syllabuses that are of general aeronautical outlook rather than peculiar to Royal Air Force requirements.

The training facilities available in Great Britain at present can be roughly summarized into groups covering the types of trainee envisaged. Repair and maintenance mechanics who are licensed by the Air Ministry, known as 'ground engineers' or 'licensed aircraft engineers', have to pass examinations in certain theoretical aspects of their work. The manufacturing firms, sometimes in conjunction with the local educational authorities, hold classes of this kind. The craftsmen who actually build the firm's products are distinct from these repair men, and do not necessarily hold ground engineer certificates. Their training is of rather a broader outlook and is catered for by the City and Guilds of London Institute (Technological Department), which holds an annual examination called "Aeronautical Engineering Practice". Classes for this are held by the local technical institutions. Apprentices needing a more theoretical training can enter for either national certificates sponsored by the Board of Education and the Institution of Mechanical Engineers, external university degrees, or the associate fellowship of the Royal Aeronautical Society, taking such aeronautical subjects as are available in the curriculum at their teaching institution. Some employers allow their apprentices to undertake some form of sandwich system of training, under which they can give sufficient time to theoretical study in their local institution to be considered as full-time students. They then enter for national diplomas or internal degrees, with similar aeronautical subjects. Some entrants prefer to enter upon a full-time course of study direct from school, and leave their practical training until they have obtained their theoretical qualification. They will take similar courses for either national diplomas or university degrees. There is a certain advantage in this latter system in that if a student finds that he has a flair for the more scientific work, and does not wish to take up the engineering side, he can pass on to study for the higher branches of scientific research without spending his time in a works. The advisability of ignoring the applied side of any science is open to question, but there may be some aspects of aeronautical science, the more mathematical, for example, where an intimate knowledge of the engineering work is not so important. Lastly, there is postgraduate study available for either of the foregoing men who desire to take up the more scientific work and feel that they would profit by a year or more extra study of the particular aspect of the profession that appeals to them. Such students will probably take up either research or the more responsible posts in design or industrial organization.

This is the programme of training as available at the present time, but there is a school of thought that holds the view that there is one serious gap in this. They consider that advanced postgraduate study at a university is academic in character, and while it is correct for the scientific man and research worker, it is not near enough to the applied side for the industrial entrant. They ask for a postgraduate institution of a more practical character, where much of the teaching would be given by visiting lecturers who are actually practising in their profession, and possibly where flying also could be done at the same time. Such flying would, of course, be looked at from the point of view of being supplementary to the technical training being given, and for the development of the technique of flying and its various auxiliary services, rather than the mere mechanical handling of an aircraft. This view was propounded by Sir B. Melvill Jones at a recent meeting of the Royal Aeronautical Society, and it is understood that it is held by a special panel of the Aeronautical Research Committee which is investigating the question of training in aeronautics for the Government.

The problem that has now to be faced in the world of aeronautical training is two-fold. First, it is necessary to consider the present system, that has been functioning to a gradually increasing extent since 1919, and to use the post-war reconstruction period to correct its shortcomings, if any, at the same time allowing for a substantial increase in the size of the industry as compared with 1938, before the commencement of the present War. Such alterations may be necessary both in size and quality. Secondly, it is necessary to organize the practical side of the industrial training, apprenticeship, etc., in such a way that it accommodates itself both to the new conditions in the general educational scheme, and the improved theoretical aeronautical training facilities that will be available consequent upon this enlargement. There will also be an interim problem of dealing with the younger people who have developed an interest in aeronautics by reason of their war-time work, either in the services or industry, and wish to make it their profession. They will have received a partial training in the practical side of the work—probably a specialized but narrow one due to the war-time necessity of becoming expert in one job only—and will need a rather special training to enlarge this and add the theoretical outlook in as short a time as is reasonable.

To come to concrete proposals, the existing scheme is fundamentally correct, and, possibly with t addition of the proposed more practical postgradua school, adequately covers the ground. At present fails to bring forward sufficient trained men on because it is not used to its fullest extent. Th failure is difficult to explain, but it is none the le very real. To those working behind the scenes aeronautics, the fact that there were insufficie well-trained persons coming along has been obvio for many years. The sources of supply can be divid roughly into two parts, the apprentice and the fu time, mostly university, man. The apprentices a taken on in works generally according to numbe agreed upon with the appropriate trades unions, a are presumably sufficient to maintain the supply new craftsmen. Most of these appear to start some form of theoretical study under schem arranged by the employers, but only a woefully sm number of them ever reach the stage of taking a of the qualifications that stamp them as being of u for the professional side of aeronautical work. T full-time students' case is different, but the resu are equally disappointing. Aeronautics deman fundamental training in the underlying subjects a then adds training in the application of them to own work. This postulates a longer and m arduous training, which only a few seem to have t ability, enthusiasm, and financial resources to co plete. Somehow this source of recruitment to t more technical side of the work must be increas Fundamentally, the matter would probably set itself in time if the conditions in the profession w made more attractive; but in the meantime so propaganda would seem to be necessary to rou sufficient enthusiasm in the minds of the younger m who will be entering their training period in t immediate future. An increase in the number institutions offering classes in aeronautics would h the general situation, and in this case such edu tional authorities might be expected to display vis in their programmes, and offer such facilities ev though it is not yet established that there exists a lo demand for them. Consultations with the lo A.T.C. organization might prove a fruitful sou of recruitment for the more elementary classes least.

The failure of so many apprentices to 'stay t course' on the theoretical side indicates that employ might do more to rouse their enthusiasm, and th possibly a certain proportion of the apprenticesh available should be reserved for boys whose sch records mark them as being of the more studious ty A proper apprentice supervisor, with the corr outlook and the necessary authority, should be a to watch his charges and possibly allow the m likely ones to give a progressively increasing amo of their time to their technical studies, as they be to show that they are likely to be of more use in t work than with their hands.

The problem of those returning from the Force national service in industry will be as thorny a as it was after the War of 1914–18, but there is fact that is outstanding as a result of our experie then. Selection of men to take up the theoret ide of aeronautics must be made with great dis-rimination. A mere interest in the subject, by eason of having done war work of a practical nature n it, is not enough. The special knowledge demanded by the aeronautical profession is not easy to ssimilate, and if it has to be done in an intensive ourse, the difficulties will be even greater. A revious interest in aeronautics added to a good war-ime record in it is almost a *sine qua non*. School ualifications sufficient to be able to understand the ork is necessary, but enthusiasm for the profession f aeronautics is equally essential for the hard task hat they are undertaking. The man who merely akes up a university course as a way of obtaining living for the immediate future will always be a roblem to the teaching world. That he should be llowed to fill a place in the scheme for higher training n aeronautics, which will be strained to its utmost imit, is unthinkable.

THE ADVANCED THEORY OF STATISTICS

he Advanced Theory of Statistics
y Maurice G. Kendall. Vol. 1. Pp. xii+457.
London: Charles Griffin and Co., Ltd., 1943.)
2s. net.

THIS very handsomely produced volume is one which it will be a pleasure to any mathematical tatistician to possess. Mr. Kendall is indeed to be ongratulated on the energy and unswerving per-everance needed to complete his heavy task, and ncouraged in the still unflagging energy which will e needed for the second volume. So far as he has arried his work, he has certainly done something to ustain the credit of Great Britain in mathematical cholarship.

In his preface, the author explains that his original ntention had been to write in co-operation with four ther distinguished statisticians. In the event we must congratulate ourselves on the fortunate fact hat the intervention of the War compelled him to arry the work out on his own plan, and without the upport and encumbrance of such collaboration.

On the many occasions on which I have been onsulted as to the feasibility and desirability of a arge-scale work on mathematical statistics, I have ointed to the discouraging circumstance that the dvances of recent decades had been so subversive, ot only to the methods but also to the points of iew from which statistical problems are approached, hat any presentation containing material expected y, and acceptable to, the leading minds of an earlier eneration would come soon to be recognized as ointless and obsolete. Mr. Kendall deals tactfully ith this difficulty, though without altogether solving t. Thus at first sight his contents pay at least formal espect to the old convention of expounding statistical methods under the headings, measures of central endency, measures of dispersion, and finally, crown-ng the arch, measures of correlation. The last four f the sixteen chapters in this volume are indeed iven up to various coefficients of correlation and ssociation, not, it is true, quite in the old style, for he subjects are treated with a mathematical com-etence, based on a wide familiarity with the litera-ure, far beyond anything previously attempted, but one is tempted to say also, beyond the intrinsic interest or practical utility of the methods under discussion. Why should anyone now wish to calculate a rank correlation, or a coefficient of contingency ?

The modern reader, on the other hand, would like to see a much fuller development of Chapter 10, on exact sampling distributions, and a far wider and more varied exposition of the uses of the χ^2 distribution than is supplied in Chapter 12. In the case of both these chapters, the subjects of which are of the greatest importance to the statistical reader, the approach is barred by an opening section of quite unnecessarily complex algebra. The perfunctory treatment of χ^2 suggests that Mr. Kendall is not immune from the weakness of other heavily burdened authors to scamp those portions of the work in which they are not particularly interested.

The same perfunctory attitude emerges on p. 59 in a short section devoted to the calculation of factorial moments by successive summation. The author says : "The use of the method in practice lies in the fact that for certain calculating machines the progressive summation is easier to carry out than the processes involved in the method of Example 3.1".

From one very highly equipped machinist to another, this may be true enough, though surely an understatement, for a method which replaces a large number of multiplications by an equal number of additions. The saving of labour is evidently most important when no machine is used at all, a condition in which even the most perfectly equipped among us must occasionally work. The method also of abbreviating the process further by summing from both ends to a chosen origin is not given, so that, unless he has independent information, the reader is not in a position to judge how valuable the procedure really is.

The presentation of purely mathematical points is, generally speaking, careful, although, as has already been suggested, cumbrous proofs are sometimes used just where, for the general usefulness of the book, they should have been avoided. Two small points and one of greater importance are perhaps worthy of the author's attention with a view to subsequent editions.

To say, as on p. 53, that "The moment about the mean of order $2r$, if it exists, is given by" a certain expression is not logically the same as to say that it is defined by the expression, and therefore exists, if the expression has a meaning. Kendall's form of statement suggests, contrary I suppose to his intention, that there is some other condition necessary for the existence of the moment.

In examples 3.7 (p. 59) and 3.8 (p. 66) the symbols μ and κ appropriate to the population are applied to statistics derived from a sample. It is true that the sample is large, giving the heights of more than eight thousand men, and therefore the errors of random sampling will be comparatively small, but it is none the less a pity to confuse the student at this stage by blurring a distinction which will later require his full attention. The other examples, 3.9–3.11, are properly applied to distributions.

Mr. Kendall is much interested in the rather formidable algebra of the symmetric functions used in mathematical statistics. Thus the formulæ for translating moments into cumulants and *vice versa* are set out in full to the tenth degree on pp. 61–64, and in other parts of the book a good deal of space is given to proofs establishing similar relationships. In my own experience the approach to all work of this kind is greatly eased for the majority of mathematical statisticians by a preliminary consideration of the nature of partitions, and an introduction to the appropriate terminology and notation. Whereas, however, in Chapter 3, on moments and cumulants, mention of partitions seems to be carefully avoided, the reader of Chapter 11, in which more comprehensive methods of analysis are developed, is confronted without warning or preparation with the notions (*a*) of partitions, (*b*) of partitions of multipartite numbers, and (*c*) of separations of partitions, as ideas which are essential to each difficult stage of the argument. The fact is that some mathematical statisticians have thought about partitions and in terms of partitional notation, while others have not done so at all. These are not going to be helped, but only baffled by the manner in which the ideas are here introduced.

Each chapter is followed by a series of exercises, some of which are exceedingly good. Some examples in the text are at least equally difficult to the reader anxious to understand the solution. Thus in example 7.2, the following argument is used to demonstrate the recurrence formula, which yields very prettily the series of sub-factorials developed by Euler for the problem of the game of *Rencontre*: "Suppose that u_n is the number of ways in which all the letters go wrong. Consider any two letters. If these occupy each other's envelopes, the number of ways in which the remaining $n-2$ letters can go wrong is u_{n-2}; and there are $(n-1)$ ways in which two letters can be interchanged. But if one letter occupies another's place and not vice versa, which can happen in $(n-1)$ ways, there are u_{n-1} ways in which the others can go wrong". I have not made the test widely, but I submit that very few mathematicians unfamiliar with this particular argument would be able from this form of statement to see where the two factors $(n-1)$ really come from.

R. A. FISHER.

ORE DEPOSITS

Ore Deposits as related to Structural Features

Prepared under the direction of the Committee on Processes of Ore Deposition of the Division of Geology and Geography of the National Research Council, Washington, D.C. Edited by W. H. Newhouse. Pp. xi + 280. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1942.) 44*s*. net.

THE study of the genesis of ore deposits does not appeal to geologists in Great Britain (with a few notable exceptions) to anything like the same extent it does in the United States and Canada. In America a great and growing number of men have adopted economic geology applied to mining as a profession, and interesting contributions to the science regularly appear in the scientific and technical press. The reason may be due to greater interest shown in mining ventures by people in America, or may result from greater opportunities for practising the profession provided by the many diverse types of deposits found there.

In any event, the rapid expansion of the non-ferrous mining industry in the United States has stimulated the scientific study of the deposits themselves. In a few outstanding cases, such as manganese in the Gold Coast and coal in Kent, the geologist either actually discovered or predicted the presence of the mineral, but in the majority of instances 'finds' by prospectors have created the need for geological specialists to interpret the discoveries.

Some decades ago, geologists in Great Britai paid more attention to the problems of the meta mining engineer, but with the decline of non-ferro metalliferous mining the interest of the majorit waned. This is unfortunate because, while it is tru that most of the easily accessible deposits have bee worked out, there exist several areas which, if tho oughly explored, might again yield discoveries whic could be worked successfully in spite of worl competition.

This book, which is published by the Princeto University Press and prepared under the directio of the Committee on Processes of Ore Deposition o the Division of Geology and Geography of th National Research Council, Washington, and i edited by Prof. W. H. Newhouse of the Massachusett Institute of Technology, can be divided into tw parts. The first portion consists of a general discussion on the controlling effects of structural feature on the deposition of various ores, while the secon and major part contains short discussions by som sixty different contributors on particular ore deposits to illustrate the diverse effects of variou geological features. The studies do not enable an hard and fast rules or laws to be promulgated, bu the deposits do fall within a broad classification.

Mining geology is not yet, and probably never wil be, an exact science, because there are too man exceptions to general rules; but a careful study o this work will afford guidance to many a geologis when confronted with a difficult problem concernin a particular deposit, and it is therefore recommende as a valuable book of reference which should b included in every library of scientific books.

The book is very well illustrated and the prin easy to read, but it is too bulky to form part of field library. As is only to be expected with a volum containing contributions by so many America writers, the ordinary reader who has been so unfortunate as not to have received some of his training i America will find difficulty in translating some of th scientific or technical terms used into those wit which he is more familiar.

J. A. S. RITSON.

DEMONSTRATION-LECTURES IN PHYSICS

Analytical Experimental Physics

By Prof. Harvey Brace Lemon and Prof. Michae Ference, Jr. Pp. xvi + 584. (Chicago: University o Chicago Press; London: Cambridge Universit Press, 1943.)

THE purpose of this book, as stated in the preface is to provide a record of demonstration-lecture which were given to second-year students attending general course of physical sciences at the Universit of Chicago. Will it fit any British syllabus? A comparison with those of the University of Londo will be a stage towards deciding this question. Th book contains what is needed for London Intermediate Science, and much more besides. Of th twenty questions set in the London External Genera B.Sc. in June 1938, seven can be answered fully wit the aid of this book, seven partly; and on th remaining six it gives no guidance. The deficiencies for this purpose, are mostly that useful genera notions are not developed in sufficient quantitativ detail. For examples: (i) pairs of separated thi lenses are treated, but not by the method of principal points; (ii) the potential energy of an electrostatic system is worked out for two conductors, but not for many; (iii) a formula for the bending of a beam is stated without proof; (iv) it is assumed that the gravitational attraction of the earth for all bodies near or far acts as if the mass of the earth were all concentrated at its centre. Electromagnetic waves receive scant attention. Yet in other directions the book goes far, treating, for example, the gyroscope, the mass-spectrograph, the three-colour analysis of vision, and the triode-amplifier; but not the triode-generator. The reviewer is left wondering to what extent syllabuses in Britain and the United States are determined by scientific or social necessity, and to what extent by academic habit.

The outstanding merit of the book resides in its illustrations. There are 584 line diagrams in the text. In addition, there are 64 pages, called plates, showing photographs accompanied by descriptions. Many of these photographs are taken from cinematograph records so as to exhibit the successive phases of lecture-experiments. From these sequences the student can obtain a much more vivid impression of what actually occurred than he could from a single line diagram; but, to gain this advantage, he will probably have to make an extra effort; for the photographs inevitably show many features that are not essential to the principle of the experiment and which must be sorted out mentally. Also some essential marks are almost, or quite, invisible in the print, notably the clock-hand in several dynamical experiments. Perhaps a bright hand on a black face would have photographed better. The defect is, however, repaired by printing the clock-readings. Many of the plates are superb.

The text flows along interestingly. The discoverers, of many nationalities, are mentioned with their dates, and with allusion to the more important controversies. There are exercises for the student both in calculation and in thinking out what would happen if the experimental conditions were varied. Thus the book affords that training in method and criticism the absence of which was lamented in a recent review ("Shortened Physics", NATURE, July 3, p. 7). But, with these merits, the work of Lemon and Ference could not be short. It weighs 2·3 kgm.; and inquiry of the English publishers elicits a provisional price of 42*s*.

The descriptive text is interspersed with mathematical proofs of the usual kind, employing the calculus sparingly. There is an appendix of 16 pages on pure mathematics, partly an explanation, partly a summary of useful but unproved formulæ.

There is an unfortunate muddle about the paraboloidal mirror. If we ignore diffraction, then all the rays from an infinitely distant point which are reflected by the mirror meet again in a common point-image, provided the object-point lies on the axis of the paraboloid, but not otherwise. As the object moves off the axis its image becomes increasingly blurred. Lemon and Ference call the image "aplanatic" (p. 482). But that is contrary to the usage of Abbe, who discovered the sine condition for aplanaticism, by which he meant the sharpness of the image both on and off the axis.

Detailed criticism must not hinder the recognition of the general excellence of this book by Profs. Lemon and Ference. It will be of particular value to any students who are unable to attend demonstration-lectures. LEWIS F. RICHARDSON.

PETROLOGY OF IGNEOUS ROCKS

Eruptive Rocks

Their Genesis, Composition, Classification and their relation to Ore-Deposits; with a Chapter on Meteorites. By Dr. S. James Shand. Revised second edition. Pp. xvi+444+3 plates. (London: Thomas Murby and Co. Ltd.; New York: John Wiley and Sons, Inc., 1943.) 25*s*. net.

THIS second edition of Prof. Shand's valuable text-book has been fully revised, partly rewritten and rearranged, and enlarged by 84 pages. The sequence of chapters is much the same as in the first edition, although their contents have been to some extent redistributed, but new chapters on the order of crystallization, compatible and incompatible phases, and eruptive rock complexes, have been inserted into the petrological part of the book. The chapter on eruptive ore deposits which formed part of the first edition has been omitted.

The result of this revision and rearrangement is that what was originally a good account of the physical chemistry and origin of igneous rocks is now perhaps the best in print. However, in the chapter on temperature and pressure in the magma, there seems to be some confusion between magmatic reservoir temperatures and temperatures of intrusion or extrusion. The conclusion on magmatic temperature (p. 69), that there is no evidence that any body of deep magma ever had a temperature higher than 1170° C., and that, in many cases, the temperature may not have exceeded 870° C., may be correct in regard to intrusion or extrusion temperatures. But in view of H. H. Thomas's work on the xenoliths occurring in basaltic sills of the Loch Scridain district (Mull), the new minerals in which imply reservoir temperatures of between 1400° C. and 1250° C. *before* intrusion, the above conclusions cannot be maintained with regard to reservoir temperatures.

Prof. Shand's powerful strictures on the Rosenbuschian order of crystallization, and on the vague uses of the ill-defined term "magmatic differentiation", will now probably be subscribed to by the majority of petrographers.

The second half of the book deals with classification, nomenclature, and description, and in this Prof. Shand excels. Something might be said in criticism of the mode of classification, which is based, as the author says, on antipathies rather than affinities between the igneous rocks, but much more space than is here available would be needed for its adequate discussion. The classification is simple, easily understandable, easily applied, economical of names, and will thus appeal strongly to the student. Researchers, however, will turn with grateful enthusiasm to the wealth of excellent digests of recent work on igneous petrography, which are drawn from the petrographical literature of the whole world, not even excluding the Soviet Union.

The book is clearly and simply written with many exciting passages in Prof. Shand's well-known pungent, not to say pugnacious, style. The chapters are headed by apposite quotations which testify to his wide humanistic reading, and end with well-selected and unhackneyed lists of literature. Although it does not consider some important aspects of igneous rocks as, for example, their distributional and tectonic relationships, the book is, in the reviewer's opinion, by far the most complete and satisfying text now available to put into the hands of the advanced student of the subject. G. W. TYRRELL.

TIME PERSPECTIVES IN SCIENCE*

By Prof. A. E. HEATH

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ONE of the best ways of broadening our minds, and clearing ourselves of local limitations and prejudices, is travel in space. Travel in time is equally effective, and cheaper. It takes us out of our narrow setting and restores our sense of proportion by confronting our parochialisms with those of other peoples and periods.

This is true in science as in other human concerns. Here, too, are fashions and unconscious temporal shortsightedness. Even inside the special sciences themselves, historical considerations are important. Although "any science which hesitates to forget its history is lost", it can equally be asserted that any science which does not relate itself to its historical background runs the risk of sterility. Its origins, as specialization increases, may be lost sight of; and dead ends appear in developing thought as in the evolution of living creatures. Its connexions with cognate studies tend to be overlooked, and fruitful possibilities of investigation, produced by a sort of cross-fertilization, neglected. The very meaning of its terms may be too narrowly conceived, as Huxley hinted when he said, "The parallax of time helps us to the true position of scientific conceptions as the parallax of space to that of a star".

It is, however, when we think of science as an instrument for furthering human ends that the full importance of its history comes to light. Viewed in its wider setting, we can see that man has, now, accumulated more knowledge than he can apply. This is sometimes spoken of as a failure in moral insight. If that were the correct diagnosis it would be a very curious thing, considering the many centuries of concentration by saints and sages on moral issues. I prefer to put the emphasis elsewhere. I should call it a failure of nerve. Wisdom is not knowledge only, but knowledge plus plasticity. We lose our nerve when we fail to adapt ourselves to change.

It is not commonly realized how modern the modern temper is. By applying a balanced form of reflexion (in which a passion for brute fact is combined with capacity for generalization) to every department of human life, we have achieved, in the last three centuries, a picture of the world which is staggeringly different from those cosmologies within the framework of which our institutions have been built. The step from Dante's world to that of Einstein and Freud has been taken much too briskly for us to keep pace. The new world is just as wonderful as the old, providing the fullest scope for philosopher, poet and prophet to work their synthesizing genius upon. But this enterprise has scarcely yet begun. We have been too much occupied with piecemeal adjustments to the disturbing political and economic developments which have followed on the heels of intellectual change. Consequently we have been forced to carry over our old mental furniture (to amplify an image of the late J. W. N. Sullivan's) into new settings for which it is ill-suited. Our first dwelling, at the beginning of this period of three hundred years, was the neat, cosy, friendly world of Dante in which we could live confidently; regarding Nature as subservient to our human purposes and destiny. From that we passed on to the wider world, big and orderly but detached, of the Newtonian system; and now, in our own day, we are translated to a vast, though bounded, universe—so bare and empty that the mind reels at its immensities and cold unconcern. Throughout all these changes we have carried with us the same homely mental furniture that served us in our first dwelling-place. It is as though we began by making shift with the contents of a small cottage when we moved into a lordly mansion in Park Lane. That would be bad enough. But the further move is like transplanting our little belongings to the middle of Salisbury Plain.

It is hard enough for us to readjust our attitude to the world outside us—to the macrocosm: but when we turn our attention inwards to the microcosm, to the little world of man and his social relationships, the difficulties increase enormously. For in this realm, too, we are carrying into the new era, with even greater tenacity, mental presuppositions about all sorts of things—about nationality, about economic realities, about sex and family—which served us in the past but may now, in altered conditions, bring ruin upon us. It is not a question of destroying our mental furniture: we cannot hope to start afresh with new minds and bodies. Our problem is, rather, how best to reshape and supplement what we already have. But before such refashioning can be begun, we have to rid ourselves of the superstitious terrors which now hinder us, in every department of social affairs, from organizing our civilization so as best to

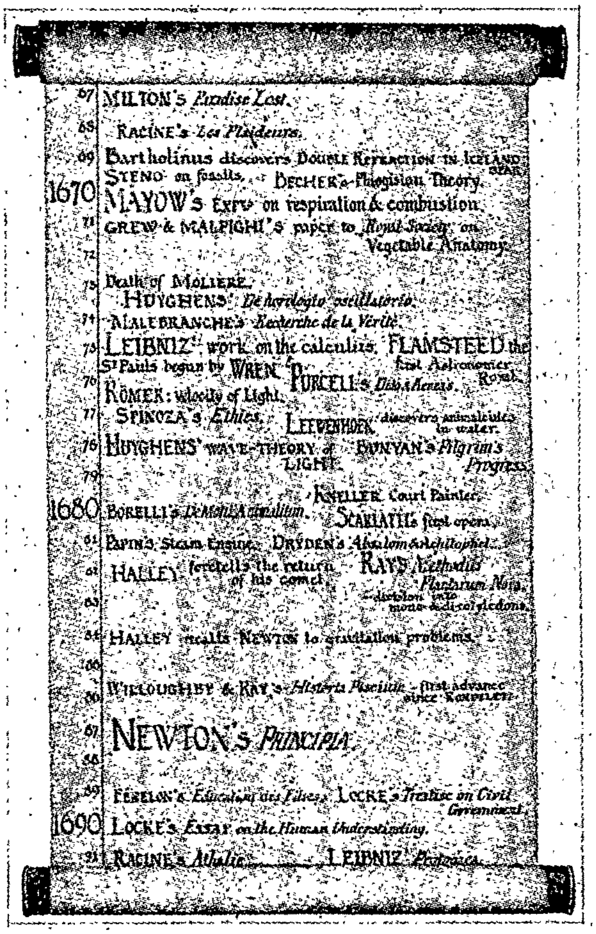
67 MILTON'S Paradise Lost.
68 RACINE'S Les Plaideurs.
69 Bartholinus discovers DOUBLE REFRACTION IN ICELAND SPAR.
STENO on fossils. BECHER'S Phlogiston Theory.
1670 MAYOW'S EXP̃S on respiration & combustion.
71 GREW & MALPIGHI'S paper to Royal Society on Vegetable Anatomy.
72
73 Death of MOLIERE.
HUYGHENS' De horologio oscillatorio.
74 MALEBRANCHE'S Recherche de la Verité.
75 LEIBNIZ' work on the calculus. FLAMSTEED the first Astronomer Royal.
St Pauls begun by WREN. PURCELL'S Dido & Aeneas.
76 ROMER: velocity of Light.
77 SPINOZA'S Ethics. LEEUWENHOEK discovers animalcules in water.
78 HUYGHENS' WAVE-THEORY of LIGHT. BUNYAN'S Pilgrim's Progress.
79
KNELLER Court Painter.
1680 BORELLI'S De Motu Animalium. SCARLATTI'S first opera.
81 PAPIN'S Steam Engine. DRYDEN'S Absalom & Achitophel.
82 HALLEY foretells the return of his comet. RAY'S Methodus Plantarum Nova. division into mono- & dicotyledons.
83
84 HALLEY recalls NEWTON to gravitation problems.
85
86 WILLOUGHBY & RAY'S Historia Piscium – first advance since Rondelet.
87 NEWTON'S PRINCIPIA.
88
89 FENELON'S Education des Filles. LOCKE'S Treatise on Civil Government.
1690 LOCKE'S Essay on the Human Understanding.
91 RACINE'S Athalie. LEIBNIZ' Protogaea.

Fig. 1.

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* Substance of a lecture at the British Social Hygiene Council Summer School at Eton College, August 1943.

serve the ends of human happiness. Scientific knowledge does not of itself free us. "Learning", as Santayana has remarked, "does not liberate men from superstition when their souls are cowed and perplexed". To the bread of knowledge must be added the salt of intelligence—by which I mean the power of plastic adjustment to change. That is the touchstone by which the future of man on this planet can be gauged, as it has been the test for every other animal throughout geological time: Can he adapt himself quickly enough to changes in his environing conditions ?

Our social and cultural disharmonies are thus largely the product of our failing to acclimatize ourselves to modern cosmologies. There is a disastrous divorce between what we know and what we feel : and to this our nerveless grasp upon our destiny is due. The prime essential for adaptation is a synthesis of the sciences of life with the sciences of the physical world. We shall need to fit our studies into a wider and more inclusive perspective. If we are to have a technocratic order it must transcend its engineering stage and become a biotechnocracy.

In the achievement of this, historical considerations are paramount, and they need not be complicated. We have the knowledge. It only needs to be effectively geared. Even such ordinary things as chronological charts provide admirable means of travel through time. These have two useful qualities. They help us, in the first place, to grasp the connexion between events in a given period ; and in the second place, to set the period itself in its proper time-relation to others.

As an example of the first, there is reproduced in Fig. 1 a small portion of a long chronological chart I made partly for my own amusement and partly because I wanted to get an idea of the historical background of scientific work in different ages. I therefore put down the names of men of science and their discoveries, varying the size of the lettering with the importance of the man or his work, in red script : and then entered on the chart, in black, events in social and cultural history. I was astonished to find how illuminating a bare chronological series of events, set out in this way on a uniform time-scale, could be. In the portion of the chart here illustrated it is possible, for example, to see at a glance that the seventeenth century was not merely the age of mechanics in its narrow sense ; that characteristic is reflected also in other branches of human activity. Besides the names of Newton and Leibniz we see that of Borelli, whose book "De Motu Animalium" is the first application of mechanical ideas to the structure of the human body ; of Spinoza, whose "Ethics" was written, under the influence of the prevailing mood of the time, in "a geometrical manner" ; of Scarlatti, who did not scorn technical experiment as a basis for composition. The whole thing hangs together.

The complete chart, upon which the sixteenth century is also entered, is several yards long, and can be moved on its rollers so that it can be looked over in a few minutes. History unrolled in this manner, by the yard, enables us to catch other unities. It becomes clear, for example, that each age has its own peculiar scientific flavour. Thus there is a certain disconnectedness in the scientific entries in the sixteenth century : it was more like the spasmodic inventiveness which still stands for 'science' in many minds. When we turn to the seventeenth century, we notice at once instances of interconnexion and co-operation. Results in one field were used in another—as when Galileo, hearing of the invention of the telescope, constructed one, but turned it immediately to astronomical use ; or when Pascal tried the effect of carrying the Torricellian tube up a mountain to see if the lessened weight of the atmosphere would be registered. The increasingly co-operative and cumulative character of science in the seventeenth century was brought out also by the appearance on the chart of the date of foundation of all the great European academies of science. This characteristic makes one realize, as nothing else can, the importance of this century for future ages ; since without it the ground could not have been cleared of the age-long accumulation of systems which cumbered it. Individual men working in isolation could not have coped with the enormous labour of putting such systems to the test of fact.

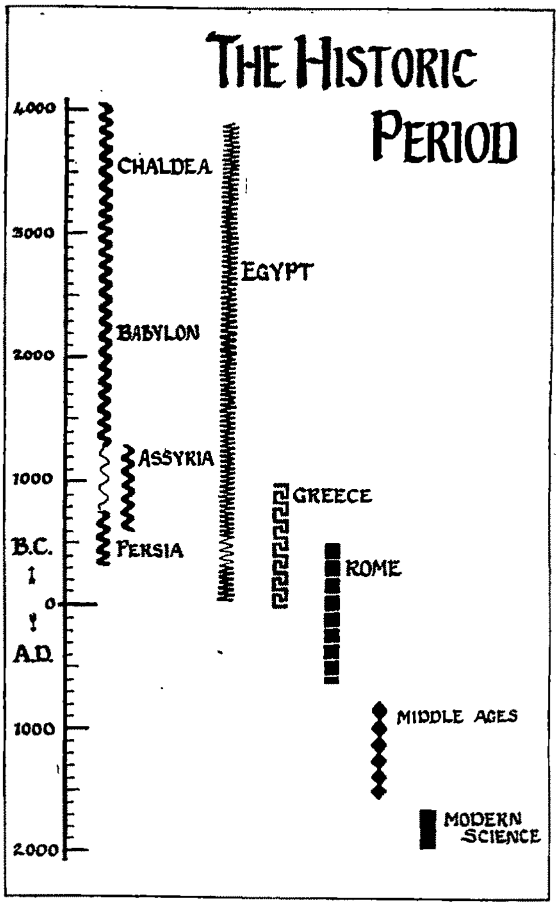


Fig. 2.

Another way in which the mere setting of events in order provided illumination was in the chart of the same kind which I made for the Middle Ages, and from which it became clear that the only scientific work in the earlier centuries of this period was under Arabic names. My own school-history had given me no hint of the fact that for several centuries the torch of Western civilization was in Mohammedan hands. Here, suddenly, I was brought face to face with it. The scraps of knowledge I possessed about the beautiful, but mysteriously early, Moorish architecture in Spain ; about Toledo steel ; about the Arabic origin of words like alchemy and algebra ; about the sources of our knowledge of classical antiquity in Arabic translations—all these fell together like the parts of a jig-saw puzzle. It was in this fashion that the detailed charts of the beginnings of modern science brought out unsuspected relationships between events and gave them new significance.

The second use of chronological charts, I said earlier, is to throw any given period taken as a whole into its wider relationships with others. For this the construction of time-lines is invaluable. If we wish, for example, to see how the modern period is related in time to the ancient world, and to the great empires which came before, we can represent them by a series of parallel lines, drawn to a common scale on a single chart. An example is shown in Fig. 2. Here is the picture of the brief period of modern scientific thought set in relation to its forerunners. It was fashionable some years ago in philosophical circles to talk about the bankruptcy of science. All that is necessary in reply is to take a reassuring glance at this chart; the balanced objective method of reflexion which we call science is too recent an acquisition for us to pass final judgment on it. It is interesting to notice, on this chart, the comparatively great length of line representing the stable early empires. It reminds us of the important fact that man has been able to build for himself solid, and even partially urban (though unprogressive), civilizations, on the basis of a rigid fibre of law—unchanging as the laws of the Medes and Persians—in which the subordination of the individual to society is far greater than in our time. Perhaps man was more docile in earlier ages, before his reflective awakening to complete social self-consciousness in ancient Greece. In our day we are forced to stress the character of *change*, because we live in a time of change and have much leeway to make up. But we must never forget that there have been many civilizations before our own; and that some of these, as in China and the East, can reach a high cultural level of an unchanging kind if they are content to remain mainly agricultural. For living renewal, cultural changes are necessary: but they must be viewed as biological processes: not like the mechanical changing of the harness of a horse, but more like a reptile shedding its skin: a delicate business, not lightly undertaken. A new biotechnology, in making this explicit, will help to free us from the exaggerated fears which tempt us to purchase security at the price of servitude.

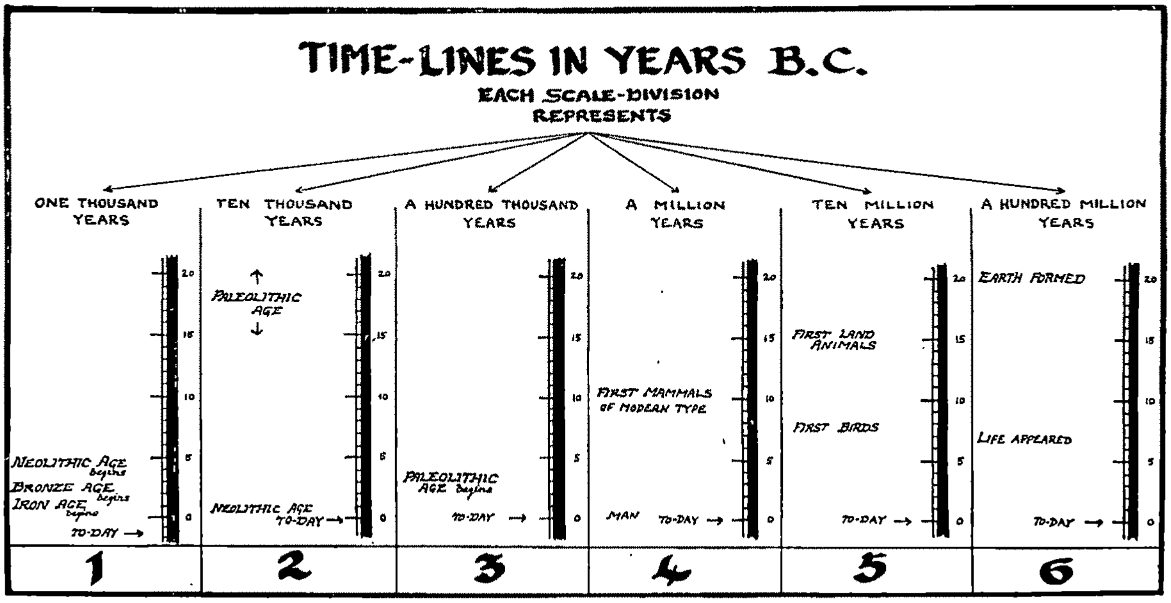


Fig. 3.

Even broader relationships of our modern period to earlier ages can be illustrated if we extend the range of our charts by making the scale successively smaller, a method used with great effect by Olaf Stapledon in one of his books. A series of time-lines constructed in this way is shown in Fig. 3. In the first of these, in which each unit of length represents a thousand years, we see the whole historical period dwarfed to insignificance in comparison with the range of man's neolithic civilization. In No. 2, where each unit is ten thousand years, this in turn is dwarfed by the vast length of the palæolithic or old stone age of man, before he had created anything but the crudest of stone weapons or developed an agricultural society. The palæolithic period indeed runs over to No. 3. We are thus enabled to comprehend the vitally important time-relation between man's hunting, agricultural and modern forms of social organization. It probably took him a quarter of a million years to create a society out of the hunting pack; and some five thousand years more to produce an ordered agricultural community. Building on his newly acquired powers over natural forces it should, Prof. J. B. S. Haldane has not too hopefully suggested, take him a shorter time to evolve a stable industrial society. Perhaps we shall be more hopeful if we remind ourselves how brief, in comparison with his whole life, is the modern period. If, now, we extend our scales still further we have on No. 4 the appearance of mammals of modern type; on No. 5 birds and the first land animals; and on No. 6 there comes at last into our ken the beginning of the earth itself.

But the beginnings of things remind us inevitably of ends. Our imagination, once started, may range forward into the far distant future: and we may pass beyond these discussions of the immediate problems of human civilization to wonder about their ultimate end in the death of the solar system.

We have been looking at man in the light of time. It may be felt that the tale is incomplete unless we also try, with Spinoza, to view him "in the light of eternity". Many will be able to face this last ordeal hopefully because they are convinced that, whatever may be the final fate of our world, there is an eternal place for man in the universe. I myself have no such conviction. Yet I do not despair—as some unhappy folk do, who have not the support of faith. To them I would offer the consolation of another journey through time under the guidance of Sir James Jeans. Imagine a clock which ticks not seconds but years. Its minutes will be a man's three score years. By this clock it was only seventy years ago that the earth was formed; only three days since man appeared; and only five minutes from the beginnings of balanced reflection. *On this scale* the astronomer gives man, at a very low estimate, another seventy years to run his course upon this planet. Mankind is thus, by this reckoning, a three-days old baby, born into a house seventy years old. He has only in the last few minutes woken up to a first awareness of his surroundings, and has the prospect of seventy years of life before him. There are moments in the lives of men, even of young men, when they fret at the passing of time. Like the Shropshire Lad contemplating the loveliness of cherry-blossom in spring, they murmur regretfully: "Of my three score years and ten, Twenty will not come again". But it is only a passing mood at twenty. It should not be a mood at all for the new-born infant.

There is another lesson to be learned from this way of viewing the human race in time. The baby is not likely to be concerned at the briefness of its life: but it is, so modern psychologists tell us, likely to be longing inarticulately for a return to the simpler conditions of dependence which it enjoyed before birth. That mood, so beautifully expressed in another of A. E. Housman's poems beginning, "Be still my soul, be still; the arms you bear are brittle", can carry forward into later life. Our infantilisms in social affairs bear witness to this. The danger which faces the human race in its present infant form is not hopelessness at the prospect of ultimate extinction, but despair at the harsh complexities of life which t is being forced to face. The real choice before us is between despairing refusal to grow up and its only alternative—resolute advance to maturity along the path of clear-eyed reflection.

STUDIES OF TWINS IN THE SOCIAL SCIENCES

By JOAN C. SQUIRES

TWINS, together with other multiple human births, have always been of interest to the society of which they are members. In primitive communiies, twins are regarded as being possessed of supernatural powers, which may or may not prove propitious to the group. Within the last seventy years, social scientists have made use of twins in an effort to solve the vexed question of the respective influences f heredity and environment on the formation of human character and physique.

There are two distinct types of twins. Dizygotic r fraternal twins are the product of two separately fertilized ova, which are independent from the moment of conception. Twins of this type have a common pre-natal and post-natal environment, but apart from these similarities, the latter enhanced by the fact that they are of the same age and thus subject to common experience, they appear to bear no more resemblance to one another than to other siblings. They may be of the same or opposite sex. On the other hand, monozygotic or identical twins are the product of one ovum, which, after fertilization, splits into two—these twins possess the same genetic constitution and are always of the same sex. Criteria for diagnosing monozygotic twins include a striking similarity in general appearance, which results in their being mistaken for one another, such as the possession of identical hair colour and texture, eye colour and pigment pattern on the iris—and a stronger cross than internal resemblance in most of the details of the finger and palm patterns—that is, the right hand of one twin resembles more closely the right hand of the other than his own left hand. It must be made clear that the term 'identical' can, in one respect, be misleading, since, as Prof. Newman points out, no two persons are born exactly alike—but he attributes the slight physical differences of monozygotic twins at birth to the inferior pre-natal position of one to the other, and the consequent decrease in blood supply[1]. The principle that all men are born equal is a political belief rather than a biological truth. The fact, however, that identical twins have the same genetic constitution, while fraternal twins differ in this respect within the limitations of the parental genes, makes the problem of heredity-environment influence easier to solve, since by series of control experiments the approximate values of these two factors can be ascertained.

Francis Galton was the first person to make a study of this problem. He examined thirty-five pairs of similar and twenty pairs of dissimilar twins, with the object of determining whether or not similar twins became unlike as a result of difference in environment, and whether dissimilar twins became more alike when living in the same environment. The segregation into similar and dissimilar was not as scientific as it would be were the experiment carried out to-day, but it approximated roughly to a division between identical and fraternal twins. Galton relied for his evidence on reports of the twins made by near relations or friends. These anecdotal sources of information have now been rejected in favour of control experiments. He was concerned more with a study of the physical than the mental characteristics. Both members of seven pairs of similar twins suffered from the same physical ailment, and there were two cases of similar insanity. Eleven pairs reported similarity in association of ideas—for example, one twin would begin a sentence and the other would end it. In nineteen cases of similar twins, however, there were marked differences in disposition, but these were ultimately attributable to illness or accident. This led Galton to the conclusion that: "we may, therefore, broadly conclude that the only circumstances within the range of those by which persons of similar conditions of life are affected, that is, capable of producing a marked effect on the character of adults, is illness or some accident which causes physical infirmity. The impression that all this leaves on the mind is one of some wonder whether nurture can do anything at all beyond give instruction in professional training. There is no escape from the conclusion that nature prevails enormously over nurture, when the differences of nurture do not exceed what is commonly to be found among persons of the same rank of society and in the same country."[2]

Galton's conclusions formed the basis of the heredity school of thought, whose views were accepted without question for some years. At the beginning of this century, however, men of science began to resume experiments with twins to test the validity of Galton's arguments. The first study of twins to make use of tests was that of Thorndike in 1905[3]. Thorndike wished to discover whether twins are more alike in abilities subject to training than in those not subject to training. With this purpose in mind he constructed tests which would measure educational achievement and those which would measure mental ability, unaffected by training, from the fact that there was no higher correlation between the attainment of twins in the educational achievement tests than in those measuring purely mental ability. Thorndike deduced that the similarity of twins was inherited rather than acquired, particularly as the correlations between twins of an older age were slightly less than those of younger twins. In this experiment there was no attempt made to distinguish between identical and fraternal twins.

Modern intelligence tests were first used with twins by Merriman in 1924[4]. He divided the twins into two age-groups—the 5–9 years old and the 10–16 years old. His results concerning the resemblance at a younger and older age tallied with those of Thorndike. He found, also, a higher correlation between twins of like sex. As one of the criteria for diagnosing monozygotic twins is that they are always of the same sex, this confirmed the fact that identical are more alike than fraternal twins. Having studied the handwriting of twins and found it not very similar, he put forward the suggestion that the similarity in growth and structure, which is found to obtain between many pairs of twins, may not necessarily extend to the finer organization of the nervous system.

Intelligence testing of twins has led to interesting results. Merriman discovered that twenty-five out of sixty-seven pairs of like-sex twins had identical intelligence quotients, and that the measurements of siblings resembled those of fraternal rather than of identical twins. Wingfield discovered that the intelligence quotient correlation between identical twins was 0·90, while that between fraternal twins was 0·70. Working with forty-two pairs of monozygotic and fifty-seven pairs of dizygotic twins, his results showed that the intelligence quotient correlation between the former was almost twice as great as that of the latter. His conclusions state, among other things, that differences in intelligence are closely related with differences in relationship, and are doubtless due to hereditary differences, but this does not mean that the intelligence quotient is not modifiable by training[5]. Hogben, who conducted experiments along the same line, discovered that the mean difference in intelligence quotient between identical twins was 9·2, while the difference in the case of fraternal was 17·8. He also made the interesting discovery that on re-testing, an identical twin resembles his co-twin more than himself, as shown by the previous test[6]. Identical heredity does not abolish intellectual differences, but it does reduce them to negligible proportions. Research in this direction has proved the idea that twins are sub-normal to be a fallacy. A person suffers from no intellectual handicap by being one of a pair of twins.

Rosanoff studied more than a thousand pairs of twins, in which one or both exhibited some kind of mental disorder, and his conclusions are of interest[7]. Reports showed that only about half the cases of mental deficiency were hereditary—the others were due to infantile diseases or birth injuries. Hereditary factors play a more prominent part in simple uncomplicated cases of mental disorder than in those associated with infantile palsy, epilepsy, behaviour difficulties and juvenile delinquency. They are also more important in the more extreme grades of mental deficiency, such as imbecility and idiocy, than in those grades commonly described as 'dull' or 'slightly subnormal'. Birth injuries are responsible for a large proportion of the latter class. Mental deficiency is more common in identical than fraternal twins, in males than in females, and in the first-born than the second-born twin. These conclusions showed that geneticists are faced with great difficulties when interpreting the pedigrees of families in which feeblemindedness is prevalent, since, as it has been shown, not all cases of mental deficiency are hereditary.

In the United States, a study of twins has recently been completed by a statistician, a psychologist, and a research worker specializing in the biology of twins[8]. The general purpose of the study was to discover the extent to which the characteristics of human beings, especially ability and behaviour, are determined by their genetic constitution, and the extent to which these characteristics are influenced by conditions of environment. In order to do this, they compared individuals who had been brought up together, but who differed in genetic constitution, that is, fraternal twins, with identical twins in similar environments, and followed this by a comparison of individuals who were genetically similar, that is, identical twins, but who had been subjected to different environments. The results of the former study showed that in the traits measured, that is, physical dimensions and intelligence, there was a higher correlation between identical and fraternal twins[9], leading to the assumption that genetic constitution is a large factor in these characteristics. Identical twins become neither more nor less alike as they grow older, but with age fraternal twins differ often in mental traits. It has been mentioned before that one member of a pair of identical twins may be born slightly inferior to the other; this initial difference may produce habitual difference—for example, it may be usual for one twin to take the lead in social intercourse. By a simple comparison of the differences in correlation between the two types of twins it was discovered that physical characteristics are least affected by environment, which has most influence on educational achievement and personality.

It was, at first, difficult to obtain suitable subjects for experiments with separated identical twins, since each of the pairs had to have been separated in infancy, and have been separated for a number of years, for the study to have any true value. Finally, the authors were able to publish reports on the cases of ten pairs of twins who had been separated in infancy, ranging from a few weeks to eighteen months old, and had been brought up in different environments for at least ten years. Small differences in environment were found to have little effect, as there were only negligible differences between the twins who had been brought up separately, but in somewhat similar environments. Whenever educational experience had differed to a marked extent, the twin with the greater amount of educational experience had a distinctly higher score on all ability and scholastic achievement tests. Where there was no or little difference in education, the scores of the separated twins tended to be as similar as those of identical twins reared together. For example, in one case, where one twin ceased her education at an early age, while the other went on to higher education and ultimately became a teacher, there was a difference of twenty-four points in intelligence quotient, in favour of the latter[10]. In another case, in which one twin had been educated at a village school, while the other had been educated at a modern school in a large city, there was a thirty-four months difference in mental age[11].

To digress from this specific study for one moment: a suggestion has been put forward by two Americans that an endowed school should be established in New York for identical twin pupils, staffed by identical twin teachers. In each grade there should be two classes, each containing one of a pair of twins, and each class should be taught by one of a pair of twin teachers. In this way, valuable work could be done in determining the best ways of teaching children. For example, one class could be taught French grammar, with no conversation, while the other could concentrate on speaking French ignoring any emphasis on grammar. Possessing the same genetic constitutions, the members of the two classes would have the same mental endowments, and therefore the difference in the ultimate result would demonstrate the value of one method as opposed to the other.

To return to the study of separated twins, the investigators state that the measurable difference in separated twins attributable to environment is, generally, equal to the sum difference in these cases plus an undetermined amount corresponding to that portion of the difference in unseparated cases attributable to environment. In weight and educational achievements, the separated twins were as different as average fraternal twins, but very similar in other traits. It can be seen that these two characteristics can be explained by the influence of environment. A marked difference in personality was found to be coupled with a marked difference in environment. For example, of one pair it was said: "These brothers, although brought up in widely different circumstances, are similar in manner and the measurable features of behaviour. However, their conduct, from the point of view of direction and social significance, differs widely. We might expect them to act with equal vigour, decision and persistence, but one to a socially constructive, and the other to a socially destructive end."

The following conclusions were drawn from this study. Every trait or character should be studied separately, for each involves different shares of hereditary and environmental factors. Physical characteristics are, in general, more influenced by heredity than mental traits; but the influence of heredity on mental ability is greater than on educational achievement.

A few years ago, Johannes Lange made a study of twins with the view of discovering whether or not the tendency towards criminal behaviour is predetermined[12]. He studied the case-histories of thirty pairs of twins, thirteen monozygotic and seventeen dizygotic, of which one or both had criminal records. Of the thirteen identical pairs, in ten cases both members had been convicted of crime—and in two of the other cases one member had suffered previously from a head injury, which may very possibly have accounted for the difference in behaviour. Of the seventeen pairs of fraternal twins there were only two cases in which both members were convicted criminals. The environmental factors were similar for fraternal and identical twins, but while there was extensive concordance in crime among the latter, there was little among the former. This was shown in the case of one pair of identical twins, both of whom were professional thieves and burglars, although they lived apart, and had had little contact with one another since youth. In his use of the twin method of study, Lange started with the assumption that if the hereditary make-up had no importance, then a comparison between identical and fraternal twins would show little difference; and lack of agreement between twins with identical heredity would enable the investigator to estimate the importance of environmental incentives to crime; and if twins with a different heredity showed closer agreement than other sibs, then environmental influences were important. Lange discovered that so far as crime is concerned, identical twins, on the whole, act in a definitely similar manner, while fraternal twins behave quite differently. Therefore, so far as the causes of crime are concerned, innate tendencies play a preponderant part, and similarity of environment does not entail similarity of behaviour on the part of fraternal twins. Heredity has a role of paramount importance; as well as exhibiting the same criminal tendencies, identical twins were found, in most cases, to follow the same patterns of behaviour in court and in prison. In one case, although in separate prisons and at different times, both twins were exceedingly troublesome and quarrelsome while undergoing sentence, showing strong paranoic tendencies. In identical twins, differences in criminal record were, for the most part, traceable to physical injuries. Social factors and those of experience can be relegated to a minor place in influence, but this does not mean that they can be discounted. Environmental factors are important to the criminal because of his suggestibility, but it is interesting to note, since environment itself depends to a very considerable extent on the type of individual concerned, that in no case did either or both members of the thirteen pairs of monozygotic twins move permanently into a different social class, whereas this did occur among the dizygotic twins, where, in one case, one twin was a Government official, while the other was a common vagrant and professional thief. We may, therefore, conclude that an underlying cause of habitual criminality is the inheritance of a predisposition to anti-social behaviour—certain hereditary dispositions are almost inevitably fated to express themselves in some form of criminal behaviour.

The results of the work of Prof. Kranz in the same sphere of research support Lange's heredity theory. The criminal records of the thirty pairs of identical twins, whom he studied, showed great concordance, while those of the forty-three pairs of fraternal twins showed concordance generally only in the fact that both twins had been convicted, not necessarily of the same crime or for the same number of times. Kranz considered that mere conviction record was not enough, since one twin may easily escape conviction. He surmounted this difficulty by a method of personal interview, which often revealed that in discordant identical twins the career of the non-convicted twin was such as to suggest a criminalistic character essentially similar to that of his convicted co-twin. He divided criminals into two types: the biologically inferior, who were chronic offenders, and those who had been led to one mis-step by unfortunate environmental circumstances: and he stated further that only the fate of the former type was predetermined by heredity.

From the results of these various studies of twins, which have helped and are helping to solve the problem of what Galton called Nature versus nurture, it can be seen that no simple answer can be given. The functions and values of heredity and environment are completely interwoven, and are not, as has been asserted by some people, intrinsically antagonistic. They vary in relative importance in regard to specific and general traits; but it can be said that, while both heredity and environment contribute to intelligence and the physical qualities of an individual, the contribution of heredity is several times that of environment. Education and training vary in relative importance in relation to the hereditary type with which they are dealing; the more intelligent the individual, the more potent the educational and general environmental influence. Environment tends to become more important as heredity becomes higher and more complicated.

Plato said that "Environment is most effective when it operates on complex nature". The forms of behaviour which constitute the adjustment of the individual to his environment at a complex level of performance are affected both by the original nature of the individual and by his environment and are not the sole product of either.

[1] Newman, H. H., Freeman, F. N., and Holzinger, K. J., "Twins: a Study of Heredity and Environment" (University of Chicago Press, 1936), 36.

[2] Galton, F., "Inquiries into Human Faculty and its Development" (New York: Macmillan and Co., 1883), 216-242.

[3] Thorndike, E. J., "Measurement of Twins". Archives of Philosophy, Psychology and Scientific Methods, No. 1 (September 1905), 1-64.

[4] Merriman, C., "The Intellectual Resemblance of Twins", Psychological Monographs, Vol. 33, No. 5 (Princeton, N.J.: Psychological Review Co., 1924).

[5] Wingfield, A. H., "Twins and Orphans: the Inheritance of Intelligence" (London and Toronto: J. M. Dent and Sons, Ltd., 1928).

[6] Hogben, L., "Genetic Principles in Medicine and Social Science" (London: Williams and Norgate, 1931).

[7] Rosanoff, A. J., Handy, L. M., Plessett, I. R., and Brush, S., "The Etiology of so-called Schizophrenic Psychoses". *Amer. J. Psychiatry*, **140**, 247 (September 1934), 247-286.

[8] See ref. 1.

[9] Ref. 1, p. 93.

[10] Ref. 1, p. 250.

[11] Ref. 1, p. 191.

[12] Lange, J., "Crime as Destiny", translated by Charlotte Haldane (1931).

OBITUARIES

Sir James Morton

SIR JAMES MORTON, who died at the age of seventy-six at Dalton Hall, Carlisle, on August 22, represented in his own person the happy combination of dye-user and dye-maker that has played so large a part in the renaissance of the dyestuffs industry in Great Britain since 1914.

Sir James was the second son of the late Mr. Alexander Morton of Gowan Bank, Darvel, Ayrshire, and was educated at the village school of Darvel and at Ayr Academy. He became the chairman of Morton Sundour Fabrics, Ltd., Carlisle, and the Standfast Dyers and Printers, Ltd., Lancaster, and a delegate director of the Dyestuffs Group of Imperial Chemical Industries, Ltd.

His attention was first directed to the problem of fabrics fast to light when he went to Carlisle in 1920 with a branch of the Ayrshire works which had been manufacturing furnishing fabrics for some thirty or forty years. The story of the development which led to the founding of the Morton Sundour Fabrics Ltd., from his first experimental exposures conducted in his greenhouse at Penrith at that time, has been graphically told by him in his monograph "Fast Dyeing and Dyes". However slight its claims as a serious historical study, this brochure illustrates to the full the energy, enthusiasm and determination which were such important factors in his success and for which he will long be remembered. His exposures at Penrith and his continental journeys led him ultimately to a range of colours which on certain types of fabrics could be guaranteed against fading from sunlight or ordinary washing. This position was reached in the summer of 1904, and in the autumn of that year guaranteed goods were first announced and sold by Messrs. Liberty in London, for which the trade mark 'Sundour' was afterwards invented. A chemical side to the business for these new developments in dyeing was then started at Carlisle, and by 1914 the Sundour factory had become the largest side of the business.

Sir James' continued interest in the dyeing side of the business is shown by a number of patents he took out in the post-war years, but the cessation of supplies of fast vat dyes, particularly of the indanthrene colours, at the outbreak of war in 1914, led him to take up the manufacture of these dyes himself. He thought that by manufacturing a blue and a yellow, by reverting to some of the dyes used in his first fast dyes, it would be possible to maintain a limited range of Sundour goods. He succeeded in tracing the synthesis of indanthrene blue and yellow far enough to find that both were derived from 2-aminoanthraquinone, which is itself obtained from sodium anthraquinone-2-sulphonate or the silver salt, an intermediate product in the manufacture of alizarin. The determination with which he pursued this objective, overcoming not merely the chemical difficulties of the syntheses but also those presented by plant and raw materials, in the course of which he founded Solway Dyes, Ltd., and later Scottish Dyes, Ltd., was largely responsible for the award to him in 1929 of the Faraday Centennial Medal on the recommendation of the Royal Society, the Royal Society of Arts and the Royal Institution "for signal service rendered to chemical science and industry in this country by developing and extending manufacture of anthracene dyes and more recently by extending their application to silk and wool". In 1929 he was also awarded the Medal of the Royal Society of Arts for his lecture on "Fast Dyeing and Dyes" already mentioned. This and his address on dyes and textiles in Britain (1930) given at the British Association meeting at Bristol in September of that year, like his monograph "To Young Weavers", find a fitting place in the literature of the dyestuffs industry.

Morton was knighted in June 1936 for his services to the dye and colour industries. He was a member of the Dyestuffs Industry Development Committee during 1921-34 and of the Committee on New Industrial Development, 1931-32. He was awarded the honorary degree of LL.D. by the University of St. Andrews in 1930 and was a fellow of the Royal Society of Edinburgh as well as an associate of the Manchester College of Technology.

He took a close interest in social welfare work connected with his Company, and in starting the branch at Carlisle bought Murrell Hill House and its grounds as a place of recreation for his workpeople. He took a close interest in the Territorial Army and in the earlier Volunteers, and during the War of 1914–18 was actively concerned in the organization and supervision of munitions-making in the Carlisle area. He had made a close study of native textiles of many countries, of which he had a valuable private collection, and was proud of the fact that he was himself a weaver and a master of that ancient craft.

R. BRIGHTMAN.

Mrs. Arthur Strong, C.B.E.

MANY visitors to Rome, as well as colleagues and friends in Great Britain, will miss the wide learning, generous disposal of it, and impressive presence of the former assistant director of the British School of Archæology in Rome, Mrs. Arthur Strong, whose death in Rome on September 16 has been reported. Eugénie Sellers was brought up in France, and obtained honours in the Classical Tripos at Cambridge, from Girton College. In the intervals of travel in Germany, Italy and Greece, she gave university extension lectures on Greek sculpture, and conducted classes in the British Museum. In 1892 she published an excellent translation of Schuchhardt's "Schliemann's Excavations" brought up to date by an epilogue from Walter Leaf. Coming under the influence of Furtwängler, she translated also his "Meisterwerke der griechischen Plastik" (1895), a more ambitious and difficult task; and with her friend, Miss Jex Blake, she published a translation and useful commentary on Pliny's chapters on ancient art (1896). Her marriage in 1897 to the orientalist, S. Arthur Strong, librarian of the House of Lords, gave her access to the great British sculpture galleries, and on his early death in 1904 she succeeded him as librarian of Chatsworth and made valuable use of the collections there, especially the gems and the archæological drawings. During these years her tastes and judgment were maturing in a revision of current opinions about the relation of Roman art to Greek. As before, she found congenial utterance first in her translation of Wickhoff's "Roman Art" (1900) but later in her own "Roman Sculpture from Augustus to Constantine" (1908), the main positions in which she restated and illustrated in her chapters on "Roman Art" in the "Cambridge Ancient History".

Mrs. Strong had long been accustomed to spend much time in Rome, and was a valued helper in the early days of the British School of Archæology there. Under the directorship of Henry Stuart Jones (1903–5) the School undertook, as a collaborated task, a "Catalogue of the Sculpture" in the public collections of the city, which she knew so well, and she took an active part in the preparation of it. In 1909, when Thomas Ashby became director, Mrs. Strong was appointed assistant director, and held office until 1925. It was a strong combination, for while both knew Rome and Italy intimately, it was from quite different points of view: both were inspiring teachers and given to hospitality; the School attracted students, and prospered. Unfortunately, the war years 1914–18 broke up the genial society of archæologists; Ashby went to war duty, Mrs. Strong found other use for her abilities. But the chance discovery in 1917 of a subterranean basilica outside the Porta Maggiore gave her in its beautiful relief decoration a new text for her teaching about Roman art, and for her growing appreciation of the symbolic aspect of ancient art in general, expressed, for example, in her lectures and eventual volume on "Apotheosis and After Life" (1916). She had already given Norton Lectures on this subject in American universities (1913).

In due course Mrs. Strong resumed her place at the British School, produced an Italian revision of her "Roman Sculpture" (1923) and delivered Rhind Lectures at Edinburgh on Roman painting (1920).

When the British School was reorganized in 1925, Mrs. Strong retired from active work in it, and in 1928 completed a comprehensive survey of Roman art to the age of Justinian (1928). In 1927 she was made a C.B.E.; and she held a life fellowship at Girton College founded for her by her friends. Still living in Rome, she maintained and extended her wide circle of friends; making most generous use of her learning and practical knowledge of Italy, and in spite of increasing disabilities, continuing her literary activity almost to the end.

JOHN L. MYRES.

Mr. H. C. Lawlor

ARCHÆOLOGY in Northern Ireland has lost a prominent figure by the death, on September 4, of Henry Cairnes Lawlor, one of the many amateur workers to whom archæological studies owe so much. This is especially true of Ulster, since unlike the National University of Eire, the Queen's University of Belfast, of which Mr. Lawlor was made an honorary M.A. in 1924, provides no instruction in prehistoric archæology.

While most amateur enthusiasts in this extremely rich province were content to amass large collections of antiquities, Mr. Lawlor showed his interest and made his chief contribution by initiating a series of excavations which were to open up many new lines of research. He was by instinct genealogist and historian rather than prehistorian, and his excavations were conducted before the refinements of modern stratigraphical methods and the significance of minutiæ had penetrated to Ulster, but his was the first cultivation of a field of research which was to blossom notably in the decade ending in 1940. His best-known excavations were those at the pre-Norman monastic site of Nendrum in Strangford Lough, but he examined many other sites in Counties Antrim and Down, ranging in date from the megalithic period to the later Middle Ages. His most original work lay in the elucidation of those most puzzling and widespread of Irish field antiquities, ring-forts and souterrains, and in the study of the earthworks of the early Anglo-Norman period.

Mr. Lawlor published many excavation reports and memoirs, several pamphlets on local history, and a more popular general account of "Ulster: Its Archæology and Antiquities" (1928). These activities were closely linked with the archæological section of the Belfast Natural History and Philosophical Society, which Mr. Lawlor inaugurated. He also took a prominent part in shaping archæological legislation in Northern Ireland and was a leading member of the Ancient Monuments Advisory Council and sectional editor of the "Preliminary Survey of the Ancient Monuments of Northern Ireland" (1940). His interest and support helped to secure the success of the revived *Ulster Journal of Archæology* (1938), on the editorial board of which he served. He also acted as local secretary for the Society of Antiquaries, and was a member of the Royal Irish Academy.

Born in Ballymena in 1870, Mr. Lawlor came to Belfast and established himself as a linen merchant; and he always took a keen interest in textile history. His character, like his calling, was typical of Ulster. A firm friend to those who knew him well, he was inclined to be stubborn in his archæological opinions and he delighted in controversy. The gap caused by his death will be hard to fill.

E. Estyn Evans.

We regret to announce the following deaths:

Dr. G. T. Bennett, F.R.S., senior fellow and sometime lecturer in mathematics of Emmanuel College, Cambridge, on October 11, aged seventy-five.

Mr. E. H. Clifford, president during 1941-42 of the Institution of Mining and Metallurgy, on October 11, aged sixty-seven.

Mr. A. C. Gardiner, biologist to the Metropolitan Water Board, on August 29.

Prof. W. F. Osgood, emeritus professor of mathematics in Harvard University, on July 22, aged seventy-nine.

Prof. W. M. Tattersall, professor of zoology in University College, Cardiff, on October 5, aged sixty years.

Captain R. D. Williams, officer in charge of clover breeding and other investigations at the Welsh Plant Breeding Station, on October 7, aged fifty-four years.

NEWS and VIEWS

British Drug Houses: Mr. C. A. Hill

Mr. Charles Alexander Hill has retired from his position as chairman and managing director of the British Drug Houses, Ltd. He has been succeeded by Dr. F. H. Carr, who becomes chairman of the company, and Mr. F. C. Oscar Shaw, who becomes managing director. Mr. Hill represents the third generation of a family of wholesale druggists, his grandfather's firm dating back to the reign of George II; he has done perhaps more than anyone else to establish a sound and progressive fine chemical industry in Great Britain and can look back on a business life of outstanding achievement. He was the moving spirit in an amalgamation of drug firms some thirty-five years ago, thus forming an organization large enough to undertake scientific research which led to the development of the manufacture of fine chemicals in a state of high purity for use in medicine. Hill actively encouraged this development on its scientific side, and among other things introduced during the War of 1914–18 the manufacture of pure reagents for use in analysis, microscopic stains, etc., and went on to supply chemicals of high quality for research purposes, displacing Kahlbaums from the position they had hitherto occupied. For this alone British science owes him a debt of gratitude. Later, the progress in medical science led to the introduction of pure hormones, vitamins and chemotherapeutic products. The production of these by British Drug Houses, Ltd., and the spirit of adventure shown by the firm, have won for it as the leading firm in the fine chemical industry a world-wide reputation.

Some fifty years back, when Mr. Hill was training, the Salters Company founded its first fellowships and scholarships, which have been so fruitful in helping some of our best chemists. The Hill family have a long connexion with the Salters Company, of which three generations have been master, and when the turn of Mr. Hill came at an exceptionally early age he was largely instrumental in forming the Salters Institute of Industrial Chemistry. He has filled many public offices, notably as chairman of the Association of British Chemical Manufacturers during two very critical and difficult years, as president of the Drug Club for four years and of the British Pharmaceutical Conference on three occasions. He can look back on a life of remarkable achievement and great development of his industry largely inspired by his efforts.

Organization of Public Medical Services

Readers who are following the discussions in the medical and general press of the proposals for a Public Medical Service put forward in the Beveridge Report will be interested in Sir Arthur McNalty's Report on the Reform of the Public Health Services, issued by Nuffield College (Oxford University Press, 2*s*. 6*d*.), to the sub-committee on post-war reconstruction of local government of which it was submitted. Its author's service as a former chief medical officer to the Ministry of Health enables him to deal with this complex subject with experience and knowledge of the many factors involved. In Part 1 he discusses the need for a wider outlook in medical teaching and practice, for the education of the public and the medical profession in public health and for reforms in general public health which seem to him desirable. Part 2 discusses the activities of the central health authorities, the organization of which is, the author thinks, needlessly complex and expensive. The frequent substitution of one Minister of Health for another, dictated by political considerations, is contrasted with the non-political organization of the Medical Research Council; a non-political director of a governing National Health Department is considered desirable.

Two illuminating pages reveal who actually does the executive work in the Ministry of Health and how many other Government departments are concerned with national health; the establishment of a co-ordinating interdepartmental committee is suggested. In Part 3 a valuable description is given of the activities of existing health authorities. The general medical practitioner, the specialist, the hospital and its ancillary services, the medical officer of health, the dentist and the research worker are all considered, and defects in the existing system are enumerated. Proposals are then outlined for the administration of general and special health services of Great Britain by local authorities or by combinations of these through regional committees. These proposals include full co-operation by the medical profession and provision of medical services for everybody. Lack of space prevents us from giving more than this skeleton outline of the report. Nuffield College is to be thanked for its decision to issue it as a contribution to the discussion of public health re-organization. The College does not, of course, take any responsibility for the views expressed in it, pointing out that it is a research institution which has no collective opinions.

Hospital Physicists' Association

An inaugural meeting of the new Hospital Physicists' Association, held by courtesy at the British Institute of Radiology on September 24, was attended by thirty-seven physicists drawn from hospitals all over Great Britain. The aims of the new Association are to discuss matters arising out of the mutual interests of those engaged in a branch of scientific work which has grown up largely in the last thirty years. Membership is open to physicists attached to hospitals, medical schools, medical or biological research departments. The meeting was followed by visits to the Middlesex, Royal Cancer and Westminster Hospitals on the next day. The afternoon session was devoted to papers. Dr. H. T. Flint spoke on technique with the various radium gram-units; Prof. F. L. Hopwood gave an account of the betatron; Prof. G. Stead discussed teaching for the diplomas and Prof. S. Russ read a paper on the professional equipment of a hospital physicist. Messages of goodwill from the National Radium Commission and the Council of the British Institute of Radiology were read at the meeting. It was agreed that there should be at least three meetings during the year, one of which should be in the provinces. Prof. Russ was elected chairman for the first year, with Dr. Wilson of Westminster Hospital acting as honorary secretary. Prof. Russ reminded his audience that the first full-time appointment as physicist to the Hospital was made thirty years ago. It is likely that to-day between fifty and sixty physicists were engaged in some capacity in hospital or medical research work. A good start was made with the new Association with plenty of evidence of vitality among its members.

Post-War Building Policy

A paper, "Housing, Town Planning and Full Employment" by F. J. Osborn, which has been reprinted from *Town and Country Planning*, points out that while the method of compartmental study of housing policy, town and country planning policy and building industry policy is essential owing to the complexity of the subject as a whole, there must also be co-ordination at a high level before major policy decisions are taken. There are, however, ominous signs of different accentuations and of a clash not far ahead. In particular, Mr. Osborn points out that the Minister of Health's housing circular of March 4 is reactionary in its planning implications, and if the local authorities act upon it before a planning policy is announced it will prejudice that policy and preclude its taking the new direction which the Government has been contemplating.

Analysing the building programme to which the Government has been committed by its White Paper of February last, Mr. Osborn considers that the programme is practical in terms of man-power, of labour, of materials, of finance, and suggests that the main difficulty will be the partly, but not wholly, obsolete dwelling. The White Paper programme cannot be carried out without the replacement of nearly all the pre-1914 dwellings in our old towns and villages. Where vacant sites are available nearby, the procedure could be fairly simple. Either the local authority could build or the Government could encourage private enterprise to do so by offering finance on suitable terms. In areas of high concentration this will not be effective, as many old houses will still have a rental value which will persist longer than twenty or twenty-five years. Consequently the total cost after rebuilding will be the present value and the cost of the new buildings which will replace them, and since these costs added together will make the rent of the rebuilt dwellings too high, the obsolete dwellings will still stand.

Mr. Osborn sees only three methods by which this obstacle could be overcome. One of these he rejects—the State to find the money for buying out the existing values of obsolescent dwellings and cancelling them, so that the sites can be cleared for economic re-building at low density. In his view a combination of the other two will be necessary: the employment of a substantial part of the building industry both by the State and by private enterprise under State stimulus in creating entirely new centres of life and work, and planned extensions of existing small towns; and third, to set statutory limit on the life of an old dwelling, a principle which is included in the Uthwatt proposals. He urges the desperate urgency of a planning policy and the necessity of facing squarely the problems of obsolescence of urban buildings and compensation for land values, and creating the machinery for controlling the location of industry and business, and for building new towns and town-extensions to relieve the pressure on space where the bulk of rebuilding has to be done.

Increase in American Longevity

According to the April issue of the *Statistical Bulletin*, the organ of the Metropolitan Life Insurance Company of New York, the average length of life of the American people has increased by almost one third since the beginning of the century. In 1941 the average expectation of life at birth was 64·36 years, which was a gain of more than fifteen years since 1901. The record was especially favourable for white females, who in 1941 had attained an average length of life of 68·08, as compared with 63·39 years for white males. Coloured persons showed a greater longevity than the white, though the current longevity among the coloured was still ten years less than for the white. The most substantial gain in longevity occurred in childhood, adolescence and young adult life, the death-rates in 1941 below forty being well under one half those at the beginning of the century. Improvements in mortality have also taken place even after forty. The favourable health situation is also illustrated by the fact that about 60 per cent of the babies now being born will live to 65 as compared with only 40 per cent in 1901. On the whole, health conditions have been very favourable in spite of the growing shortage of civilian medical men, the initiation of restrictions on food consumption, the crowding in centres of war industries and inadequate housing.

Conservation of Wild Life in Great Britain

The Universities' Federation for Animal Welfare (temporary address, 284 Regent's Park Road, London, N.3) has issued a circular directing attention to the need for co-ordinating the diverse and often conflicting interests concerned with the regulation of wild life, both fauna and flora, in Great Britain. It is suggested that a central "Wild Life Authority" should be set up by statute and charged with the duty of studying and directing all measures necessary for the control of injurious, and the conservation of desirable, species. Except that the Federation is specially concerned to urge the adoption of humane methods in the destruction of animal pests, its aims seem to differ little from those of several other existing organizations, such as those concerned with national parks, nature reserves, and the like. Further discussion will doubtless emphasize the importance of co-operation rather than competition in this, as in so many other schemes for post-war progress.

Inter-allied Bureau for Educational Reconstruction

AT the sixth meeting of the Conference of Ministers of Education of the Allied Governments held at the offices of the Board of Education on October 5, it was agreed to establish an Inter-Allied Bureau to carry out the practical steps needed to restore educational services in the countries concerned. This Bureau will be the executive body of the Conference. The work to be undertaken by the Bureau includes the purchase and distribution of books and periodicals, the preparation of films and other visual aids and the supply of scientific equipment. These matters are at present being considered by commissions of the Conference. The Bureau was also asked to consider financial needs and methods of contribution by Governments and the establishment of an inter-Allied secretariat.

Recent Earthquakes

THE United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the epicentres of four recent earthquakes. These are in scattered localities but are all in areas where earthquakes are known to be relatively frequent. The first was on July 23, 1943, at 15h. 52.9m. U.T. and occurred near lat. 10·5° S., long. 117·5° E. This is in the Indian Ocean south of the island of Soembawa, approximately between Java and Australia. The next two came from the same epicentre, the second thus being an aftershock of the first, and together showing the tendency of earthquakes to recur from the same epicentre. The first of these was on July 29, at 3h. 02m. 14s. U.T., from an epicentre near lat. 18·9° N., long. 67° W., which is in the Atlantic Ocean between Nares Deep and the island of Puerto Rico and north of the latter. The aftershock occurred on the next day, July 30, at 1h. 02m. 32s. U.T. from the same epicentre in the West Indies. The fourth earthquake occurred on August 10 at 15h. 13·3m. U.T. from an epicentre near lat. 54° N., long. 161° E., which is approximately in the middle of the east coast of the Kamchatka Peninsula and midway between the towns of Ust-Kamchatsk and Petropavlovsk-Kamchatski. The east coast of the Kamchatka Peninsula forms part of the circum-Pacific chain of instability, lying between the Japanese Islands and the Aleutian Islands. The depths of focus of all four earthquakes are considered normal and the interpretations and calculations are tentative. Data were received from seismological observatories in North and South America, Honolulu, New Zealand and Australia.

Comet Oterma (1943*a*)

AN orbit for Comet Oterma, 1943*a*, has been computed, and its eccentricity is only a little more than half that of Pluto. As a result of this small eccentricity, it will be possible to observe the comet easily throughout its orbit. This is the second comet so far discovered which possesses this distinction, the other comet being Schwassmann-Wachmann (1925, ii). The eccentricities are 0·139 for Comet 1943*a* and 0·142 for Comet 1925, ii; but the periods are very different, namely, 8 years and 16·3 years respectively.

The elements of the orbit of Comet Oterma are given below, but as it is at a considerable distance from the sun and the earth, it is not an easy object except for moderate-sized telescopes.

T	1942 Oct. 18. 1040 U.T.	
ω	5° 00′	1943·0
Ω	154 51	
i	3 58	
q	3·44	
e	0·1391352	
P	8·00 years.	

Nova Aquilæ

A TELEGRAM from Copenhagen announces that this nova attained magnitude 7 at the outburst between April 13 and May 2. Its position, referred to the equinox of 1855, is R.A. 19h. 45·5m., Dec. 8° 06′ N. It is a little brighter than magnitude 12 at present.

Announcements

MR. J. BENSTEAD, general secretary of the National Union of Railwaymen, and Mr. E. Thornton, secretary of the United Textile Factory Workers Association and secretary of the Rochdale Weavers' Association, have been appointed members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. Sir John Greenly retired from the Council on completion of his term of office on September 30.

THE College of Physicians of Philadelphia has awarded the Alvarenza Prize to Dr. Ernest Carroll Faust, professor of medical parasitology and acting head of the Department of Tropical Medicine, Tulane University, for his "outstanding contributions to our knowledge of parasitology and tropical medicine".

THE centenary meeting of the Royal Anthropological Institute will be held on October 30. Prof. J. H. Hutton, president of the Institute, will preside, and addresses will be delivered by Sir John Myres on the work of the Institute, and by Lord Hailey on "The Role of Anthropology in Colonial Development" during the morning. The afternoon meeting will take the form of a symposium on "The Future of Anthropology", in which Dr. G. M. Morant will speak on physical anthropology, Prof. V. G. Childe on archæology, Mr. R. U. Sayce on material culture and Prof. R. Firth on social anthropology. The morning meetings will be at the rooms of the Royal Society and the afternoon meetings at the Institute.

THE Nutrition Society has arranged a whole-day conference on "Post-war Nutritional Relief", at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, on November 6. The chair will be taken by Lord Horder and papers will be read by Prof. J. R. Marrack ("Past Experience and Present Position"), Dr. J. Hammond ("Problems of Production in Relation to Post-war Nutritional Relief"), Miss E. M. M. Hume ("Opportunities for Nutritional Research in the Work of Relief") and others. Details of this meeting can be obtained from the hon. secretary, Dr. Leslie J. Harris, Nutritional Laboratory, Milton Road, Cambridge.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Barometer Effect of Penetrating Cosmic-Ray Showers

DURING the past sixteen months we have recorded penetrating cosmic ray showers and barometric pressure. As it was not the main object of the experiment to correlate pressure and penetrating shower intensity, the disposition of the counter arrangement was changed frequently. Altogether two different counter arrangements with fourteen different dispositions of absorbers were used for various lengths of time. One of the arrangements has been described previously[1].

Correlation between barometer and counting-rate was determined in the usual way for each of the separate arrangements. The barometer coefficients obtained for the individual sets of readings were rather uncertain, because of the large statistical fluctuations which were to be expected in consequence of the small counting-rates usual for penetrating showers.

The weighted mean of the fourteen single barometer coefficients appears, however, significant. It was found to be

$$B = -11\cdot7 \pm 2\cdot7 \text{ per cent per cm. mercury.}$$

The stated error is the *standard error* of B.

The value of B was computed from 270 single readings covering 8,220 hours during which 4,363 coincidences were recorded. The root mean square variation of the barometer during this period was found to be ± 0·87 cm. mercury.

The fluctuations around the average values of the individual values corrected for the barometer were found to be statistical. Thus there is no indication of large variations of the intensity due to causes other than changing pressure.

The barometer coefficient B is very large and is of the same order as that found by Cosyns[2] and Auger and Daudin[3] for extensive air showers. This confirms the connexion between air showers and penetrating showers.

The large value of the barometer coefficient is, however, surprising in view of the small absorption of penetrating showers in lead. According to our previous measurements, 30 cm. of lead absorbs only about 20 per cent of the observed shower intensity. This difficulty might be removed by assuming that the absorption of penetrating showers is much greater in air than in lead. Such an assumption appears unlikely, as the penetrating showers seem to consist mainly of mesons, and the absorption of mesons is proportional to mass. The decay of mesons which gives rise to absorption anomalies would give rise to a temperature effect rather than a barometer effect.

An alternative explanation of the large barometer coefficient is that the change of intensity of the penetrating showers with barometric pressure is due not to the absorption of the penetrating showers themselves in air but to the absorption of the primaries which give rise to penetrating showers.

Consider those primaries which at a certain air pressure can just reach the top of a lead absorber placed above the counter arrangement. If 1 cm. more of lead is placed above the apparatus, these primaries will be absorbed in the additional lead. But while absorbed, these primaries will give rise to penetrating showers which will be recorded. On the other hand, if instead of the additional lead absorber the air pressure increases by a corresponding amount, the primaries which would have just reached the top of the absorber will now be absorbed about 100 m. above the arrangement. The penetrating showers which are produced will reach the apparatus too diffused to give rise to coincidences. Thus the barometer effect is a measure of the rate of absorption of the primaries.

This point will be dealt with in detail in another paper.

L. JÁNOSSY.
G. D. ROCHESTER.

Physical Laboratories,
University of Manchester.
Sept. 15.

[1] Jánossy and Rochester, NATURE, 150, 633 (1942); *Proc. Roy. Soc.*, in the press.

[2] Cosyns, NATURE, 145, 668 (1940).

[3] Auger and Daudin, *Phys. Rev.*, 61, 91 (1942).

Boiling Point and Viscosity of Gases

RECENT experimental studies[1] on the compressibility of liquids and liquid-mixtures indicated the existence of a connexion between the compressibility and viscosity. The usual equations representing viscosity – temperature relation of liquids do not, in any form, contain the compressibility function. After trial, it was observed that the viscosity of liquids could be well represented by an equation of the form :

$$\eta = AT^{1/2}e^{B/\beta}, \tag{1}$$

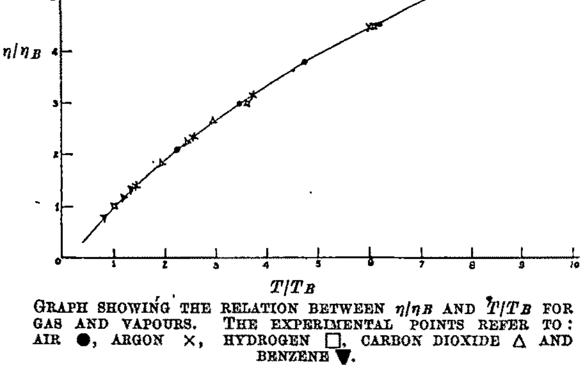
where A and B are constants, and β is the adiabatic compressibility. β, at any temperature, was calculated from the supersonic velocity and the density of the liquid for that temperature.

I was led, further, to consider the question of the viscosity of gases, and from considerations of interaction energy at collision, the following simple formula was obtained, giving the viscosity η at the temperature T :

$$\eta = AT^{1/2} \text{ exp.} - (T_B/T)^{1/2}, \tag{2}$$

$$\text{or } \eta/\eta_\beta = xe^{(1-1/x)}\text{; } x = (T/T_B)^{1/2}, \tag{3}$$

where T_B is the boiling-point temperature and η_B the viscosity of the gas at that temperature. The relationship was tried and found to hold good for air, argon, hydrogen, nitrogen, oxygen, carbon monoxide



GRAPH SHOWING THE RELATION BETWEEN η/η_B AND T/T_B FOR GAS AND VAPOURS. THE EXPERIMENTAL POINTS REFER TO : AIR ●, ARGON ×, HYDROGEN □, CARBON DIOXIDE △ AND BENZENE ▼.

and carbon dioxide, as well as for vapours like benzene, carbon disulphide, chloroform, carbon tetrachloride, etc., throughout the range of temperature where viscosity measurements are available.

The accompanying curve represents η/η_B plotted against T/T_B as given by equation (3). It will be noticed that the observed points for air, argon, hydrogen, carbon dioxide and benzene all fall on this 'universal curve'. The fit is equally good in the case of other gases and vapours. The formula holds for ordinary range of pressures. Since the boiling point depends on pressure, equation (2) indicates the dependence of the viscosity of a gas on pressure. It may be noted, however, that for pressure changes which are not large, variation in the boiling point and the resulting variation of viscosity would be scarcely observable. A change in the indicated direction is, however, to be found in the experimental results of Kundt and Warburg when the pressure change is not very large.

The detailed account of this work is being published elsewhere.

A. DUTTA.

Physics Department,
University of Delhi,
Delhi.
May 10.

[1] Parshad, R., *Indian J. Phys.*, 15, 323 (1941).

Structure of Geranylamine Hydrochloride

THE ambiguity in the interpretation of fibre diagrams makes it doubtful whether satisfactory solutions for the crystal structures of rubber and the gutta-percha isomers will be possible until a more detailed knowledge of the stereochemistry of the polyisoprene system is available. Accordingly a complete crystal structure analysis has been made on the simple di-isoprene derivative, geranylamine hydrochloride,

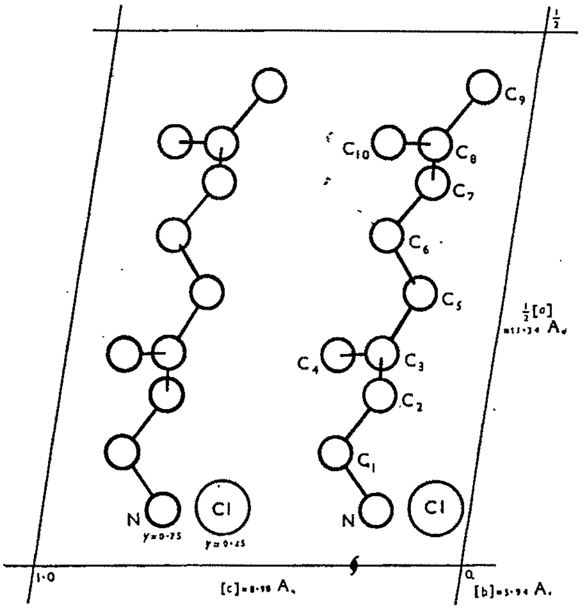
$CH_3.C.(CH_3){:}CH.CH_2.CH_2.C.(CH_3){:}CH.CH_2.NH_2.HCl.$

From the experimental data of 1,060 observed reflexion intensities, it has been possible by extensive trial and error calculations followed by three-dimensional Fourier syntheses to establish the parameters for each atom (excluding hydrogen) to an accuracy of about ± 0·03 A. The space group is $P2_{1/c}$, and a diagram of the two glide-related molecules projected on to half the basal plane of the monoclinic cell is shown in the accompanying illustration. The interatomic distances are as follows :

Cl—N	3·23 A.	C_2—C_3	1·31 A.	C_6—C_7	1·52 A.
N—C_1	1·49	C_3—C_4	1·53	C_7—C_8	1·31
C_1—C_2	1·54	C_3—C_5	1·51	C_8—C_9	1·53
		C_5—C_6	1·43	C_8—C_{10}	1·54

In both isoprene units, which are identical, the disposition of valencies about the ethylenic double bond is strictly planar and the angles are normal to within ± 5°.

The most significant feature of the structure is the shortening of the C_5—C_6 bond, accompanied by a planar configuration of carbon atoms 3, 5, 6 and 7. This implies a hybrid bond comparable, for example, to the formally single bond in butadiene. The double bonds cannot be considered as completely insulated and some degree of triene conjugation must be envisaged, $-C{=}C{-}C \overset{\cdots}{-} C{-}C{=}C-$. Since it is not apparent how the saturated quaternary ammonium pole can be solely responsible for this molecular modification by creating appropriate canonical states, the high electrostatic charge of the N+ must be considered as merely enhancing an effect inherent in the hydrocarbon system. After inductive transmission to the nearer double bond, electron attraction farther along the chain will only be appreciable if it can be relayed by a tautomeric (mesomeric) displacement. Precisely such a mechanism is provided by invoking and developing the incipient conjugation previously suggested[1] as a normal feature of 1 : 5 diene systems by virtue of hyperconjugation involving the α-methylenic C—H bonds.



The details of the complete X-ray analysis will be published elsewhere, together with a discussion of its bearing upon the problems of the natural polyisoprene structures.

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[1] Bateman, L., *Trans. Faraday Soc.*, 38, 367 (1942).

A New Technique for the Ultimate Microanalysis of Organic Compounds

UNDER this title, Ronald Belcher and Cyril E. Spooner[1] have described an apparatus for the combustion of organic compounds, consisting of a combustion tube which is not filled with any contact material. The authors refer to their previous publication of a similar macro-method[2], and state that they "originated this unpacked tube technique for the ultimate analysis of Coal", and further say that "so far as we are aware this was the first use of an unpacked tube for this purpose, and we have now adapted it to the micro-scale".

In view of these claims may I be allowed to state that neither combustion analysis without contact material nor its adaptation to the micro-scale are new. In fact, this kind of technique has been repeatedly described by a number of authors from 1864 up to the present time, namely, by C. N. Warren[3],

W. G. Mixter[4], A. Sauer[5], Marek[6], W. Grote and H. Krekeler[7], and A. Schöberl[8]. The latter describes micro-version. As a safeguard against explosion, C. N. Warren fills his combustion tube with asbestos, while Grote, Krekeler and Schöberl enclose the heated area within two sintered plates for the same reason. These precautions do not, however, alter he fact that contact materials are not used. One further variant by H. ter Meulen and J. Heslinga[9] must be mentioned in this connexion. These analysts recommend the use of some quartz splinters in front of an unpacked heated area.

F. B. STRAUSS.

Dyson Perrins Laboratory,
The University, Oxford.
Aug. 28.

[1] Belcher, R., and Spooner, C. E., *J. Chem. Soc.*, 313 (1943).

Belcher, R., and Spooner, C. E., *Fuel*, 20, 130 (1941).

[3] Warren, C. N., *Z. Anal. Chem.*, 3, 272 (1864).

[4] Mixter, W. G., *Amer. J. Sci.*, (3), 4, 90 (1872).

[5] Sauer, A., *Z. Anal. Chem.*, 12, 32, 178 (1873).

[6] Marek, *J. prak. Chem.*, (2), 84, 713 (1911).

[7] Grote, W., and Krekeler, H., *Angewandte Chem.*, 46, 106 (1933).

Schöberl, A., *Angewandte Chem.*, 50, 334 (1937).

[9] ter Meulen, H., and Heslinga, J., "Neue Methoden der Organisch-Chemischen Analyse", Leipzig, 37 (1927).

Change of Symmetry of Basic Beryllium Acetate

Preston and Trotter[1] have described a change of symmetry with temperature in the Laue photographs of basic beryllium acetate, $Be_4O(CH_3COO)_6$. This change of symmetry, according to Preston and Trotter, is a reversible one and occurs between 30° and 50° C. At the higher temperature the crystal class possesses three-fold axes with parallel mirror-planes, whereas at the lower temperature only the three-fold axes are present. Preston and Trotter suggest that the increase in symmetry is due to the setting in of molecular vibration of the acetate groups.

We have taken single-crystal photographs of this substance at temperatures between 15° and 80°, using a special Weissenberg camera. These photographs show the change of symmetry very beautifully. Below 25° a spot $(hk0)$ has in general a different intensity of reflexion from $(kh0)$. As the temperature is raised above 25°, however, a change begins which becomes complete at 40° whereby the $(hk0)$ and $(kh0)$ reflexions become equal in intensity. The change is especially rapid between 37° and 40°. As found by Preston and Trotter, the change appears to be completely reversible with no hysteresis.

The Weissenberg photographs give the complete set of $(hk0)$ intensities, and permit the changes in atomic parameters to be followed by Fourier synthesis. The signs of the F values are obtainable from the Pauling and Sherman structure[2]. The results of this work enable the following conclusion to be drawn. As the temperature increases from 25° to 40°, there is a gradual change in the parameters of the carboxyl oxygens from the values $(\overline{0{\cdot}17}\ \overline{0{\cdot}06}\ \overline{0{\cdot}04})$ to the values $(\overline{0{\cdot}17}\ \overline{0{\cdot}05}\ \overline{0{\cdot}05})$ respectively. All other atomic parameters remain unchanged. The low-temperature values $(\overline{0{\cdot}17}\ \overline{0{\cdot}06}\ \overline{0{\cdot}04})$, which correspond closely to the Pauling and Sherman structure, mean that the oxygens are already within 0·23 A. of the 110) planes, which become the mirror planes at 0° C. As the temperature is raised above 25°, there is a gradual displacement of all the carboxyl oxygens until at 40° they lie exactly on the (110) planes.

There is thus no question of the setting in of any abnormal thermal oscillations in this crystal. The effect observed by Preston and Trotter is merely due to a small change in the atomic parameters. The change corresponds to a rotation of the CH_3COO groups about the line joining the two carbon atoms, and is such as to make very little alteration in the distances within the molecule. Some of the intermolecular distances (van der Waals' bonds) are modified slightly.

This crystal would seem to permit a very accurate determination to be made of the size of the –COOH group, and indeed was used for this purpose by Pauling and Sherman. It is not thought that the results derived in the present work by two-dimensional Fourier synthesis are any more accurate than the result obtained by Pauling and Sherman, who used a small number of general intensities. It is thought, however, that the use of three-dimensional Fourier synthesis using all the available general intensities would enable an extremely good determination to be made.

I am indebted to Mr. T. Sheddan for growing the crystals used in this investigation, and for much help in the X-ray photography.

C. A. BEEVERS.
(Dewar Research Fellow.)

Chemistry Department,
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Sept. 15.

[1] NATURE, 151, 166 (1943).

[2] *Proc. U.S. Nat. Acad. Sci.*, 20, 340 (1934).

Apparent Vitamin C in Walnuts

THE remarkably high vitamin C content of walnuts has been mentioned by various workers[1,2]. Recent work[3,4] indicates that foods may contain substances which react with the dye and are estimated as ascorbic acid under the usual titration conditions but are not true vitamin C. This apparent vitamin C has now been found in walnuts. Twenty-one samples of five different species have been examined, and all were found to contain considerable amounts of apparent vitamin C (see accompanying table). The *Juglans regia* samples were collected in Kew, Long Ashton and Berkhamsted. All the other samples came from Kew. The flowers of many trees of Juglans and Carya were destroyed by frosts, which prevented the investigation of a wider range of species. The material available was further restricted by the depredations of grey squirrels, at present a serious pest at Kew. The nuts ranged in weight from 2 gm. to 40 gm., and included different stages of ripening up to those in which the shell had become hard and woody. Thus, apparent vitamin C should be found in walnuts which are pickled or used in jam-making, etc. Mapson[5] has found that 14 per cent of the total vitamin C in some walnuts preserved in syrup was apparent vitamin C.

In our investigation the apparent vitamin C was estimated by Mapson's visual method and by our own visual and potentiometric methods[6] on a number of samples. All three methods showed the presence of the apparent vitamin C and (with certain exceptions to be considered in a later communication) the results by the three methods were in reasonable agreement. The apparent vitamin C was not due to tannin, since the results were not appreciably

Species	No. of samples examined	Total vit. C content mgm. per 100 gm.		Apparent vit. C as per cent of total	
		Range	Mean	Range	Mean
Juglans regia	6	1390—2968	2070	19—50	31
Juglans nigra	7	950—2660	1700	23—51	31
Juglans rupestris	6	1022—1606	1360	5—28	18
Juglans cinerea	1	1250	1250	73	73
Carya ovata var. *pubescens*	1	700	700	12	12

affected by removal of tannin by the method of Mirimanoff and Mori[7]. We confirm Gherghelezhiu's finding that the husk (fleshy mesocarp) of walnuts in the later stages of the growth of the fruit contains a higher concentration of vitamin C than the shell (endocarp) and the tissues enclosed within it. We have further found that the fully developed kernel contains very little vitamin C. Our finding that the concentration of vitamin C is greatest in the outermost tissue and least in the innermost tissue in walnuts is in agreement with previous findings on the distribution of vitamin C in other mature fruits, for example, oranges, lemons and tangerines[8], tomatoes[9]. The proportion of apparent vitamin C in the total vitamin C is often much higher in the husk than in the central tissues, and this appears to be associated with a higher pH.

The table shows that our results for the total vitamin C in walnuts were somewhat higher than those found by Pyke, Melville and Sarson in 1942. For example, our mean of 2,070 for *Juglans regia* is above the range of 1,500–1,800 for their results on this species. This may be due to seasonal variations or to other factors to be explored later. When allowance is made for the apparent vitamin C in our *Juglans regia* samples the mean true vitamin C is about 1,470. This is only slightly lower than the range of 1,500–1,800, and in other seasons the mean true vitamin C in *Juglans regia* might easily fall within this range. Thus our findings agree with those of previous workers in showing walnuts to be a remarkably rich source of vitamin C, but also show that walnuts in general contain considerable amounts of apparent vitamin C, which will need to be taken into account to ensure accurate estimations of their vitamin C value.

We are indebted to the Acting Director of the Royal Botanic Gardens, Kew, for providing samples of nuts, and to Miss Elaine Finnigan for assistance in making the extracts.

Details of this investigation will be published elsewhere.

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Royal Botanic Gardens,
Kew.

FRANK WOKES.
JOAN G. ORGAN.

'Ovaltine' Research Laboratories,
King's Langley, Herts.
Sept. 18.

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[1] Gherghelezhiu, *Bull. App. Bot. Genetics*, Plant Breeding, U.S.S.R., Supp. 84, 2, 206 (1937).

[2] Pyke, Melville and Sarson, NATURE, 150, 267 (1942).

[3] Mapson, NATURE, 152, 13 (1943).

[4] Wokes, Organ, Duncan and Jacoby, NATURE, 152, 14 (1943).

[5] Mapson, unpublished results.

[6] Wokes, Organ, Duncan and Jacoby, unpublished results.

[7] Mirimanoff and Mori, *Schweiz. Apoth. Z.*, 78, 685 (1940).

[8] Bacharach, Cook and Smith, *Biochem. J.*, 28, 1038 (1943).

[9] Wokes and Organ, *Biochem. J.*, 37, 259 (1943).

Vitamin C in Walnuts

WE have recently taken the opportunity c estimating the ascorbic acid and 'total' ascorbic aci (that is, ascorbic acid plus dehydroascorbic aci calculated as ascorbic acid) contents of the epicarp of two varieties of ripe edible walnuts (*Juglans regia* In each case the endocarp was very hard, the epidermis was beginning to show dark patches and th epicarp was very juicy and possessed an odour simila to that of juglone (5–OH 1 : 4 naphthaquinone). Th results are given in the accompanying table.

	Conc. of ascorbic acid (mgm./gm. of tissue)	Conc. of 'total' ascorbic acid, or vitamin C (mgm./gm. of tissue)
1. Variety 'Wilson's Wonder'	3·86	4·04
2. Variety ?	8·75	9·30

The method of estimation used was that describe by Lugg[1,2], which makes use of the reduction of th dye 2,6-dichlorphenolindophenol by ascorbic acid and of reactions with formaldehyde as a means o distinguishing ascorbic acid from a number o extraneous reducing substances.

The metaphosphoric acid extracts contained onl small quantities of extraneous reducers, and thes were of the type which does not react readily wit formaldehyde at pH 1·5 and pH 3·5. They contributed only 5–10 per cent of the total reducing capacities of the extracts and their contributions wer scarcely affected by sulphuretted hydrogen treatment in the estimation of dehydroascorbic acid Reduced juglone was found to behave substantiall as a reducer of this type, and consequently onl several per cent of the total reducing capacities o the extracts could be attributed to reduced juglone

In so far as these extracts may have resemble the extracts examined by Pyke, Melville and Sarson[3] who used green, whole walnuts, we confirm thei belief that the great reducing capacities are du almost entirely to the presence of ascorbic acid Attention should be directed to the fact that w found only small amounts of dehydroascorbic aci in our extracts.

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R. A. WELLER.

Nutrition Laboratory,
Division of Animal Health and Nutrition,
Commonwealth Council for Scientific and
Industrial Research,
University, Adelaide. July 27.

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[1] Lugg, NATURE, 150, 577 (1942).

[2] Lugg, *Austral. J. Exp. Biol.*, 20, 273 (1942).

[3] Pyke, Melville and Sarson, NATURE, 150, 267 (1942).

A Precipitin Test for Typhoid Fever

TREATMENT of typhoid fever with the serum fron convalescents of this disease is a well-recognize therapeutic procedure. The good results obtaine are believed to be due to passive immunization, as i other forms of serum therapy. From the serologica analysis of a large number of convalescent typhoi sera it was, however, observed that their antibod content, both of *O* and *Vi* antibodies, was universall poor. On the other hand, in spite of their paucit in antibodies, such sera had proved to be ver efficacious therapeutic agents in our hands during th last few years. This experience could not, therefore be reconciled with the statements of Felix and his co-workers on the important role of *Vi* antibody, and its antigenic counterpart, in typhoid immunity and infection; in fact, this antibody forms the principal constituent of Felix's therapeutic anti-typhoid serum. Further experiments were, therefore, undertaken which revealed that when a convalescent serum was injected into human beings, as well as laboratory animals, it led to the production of an appreciable amount of *Vi* antibody and that its therapeutic efficacy was directly proportional to the amount of antibody so produced. These observations could only be explained by assuming that the convalescent serum either stimulated the antibody-forming apparatus in some unknown manner or that it contained an antigen responsible for *Vi* antibody formation. It has now been ascertained that the latter explanation is correct and the typho-precipitin reaction reported here is based on the presence of a *Vi* precipitinogen in the sera of typhoid patients both during infection and during convalescence. The qualitative and quantitative determination of this antigen has been found to be of definite significance in the diagnosis, the prognosis and the treatment of typhoid fever.

Five capillary drops of a *pure Vi* serum (titre 250–500) were measured in each one of a row of precipitin tubes with a capillary pipette (56 drops to 1 c.c.). To these were added equally large five drops of a serially diluted serum under test for its *Vi* precipitinogen content. The mixture, after being well shaken, was incubated at 37° C. for one hour. It was then left in the refrigerator overnight and the reading taken after an interval of 20–24 hours. The development of a deposit and not an opalescence was the criterion of a positive test.

No *Vi* precipitating antigen was found to be present in the sera of typhoid patients during the early stage of disease, especially during stadium incrementi. It could, however, be detected towards the end of stadium fastigium and continued to be present in considerable quantities for 2–3 weeks after the temperature had stayed normal. A large number of normal sera examined did not show its presence nor could it be detected in infections other than typhoid fever. A previous history of *T.A.B.* inoculation did not affect the diagnostic value of the test. Any evidence of flocculation was proof positive that the patient was either suffering or had just suffered from typhoid fever, especially in cases where the isolation of the infecting organism had been unsuccessful and the results of other serological reactions only suggestive of typhoid infection.

From the prognostic point of view the presence of this antigen strongly indicated that the patient was getting the better of infection. In cases complicated with toxæmia, hyper or prolonged pyrexia, abdominal or meningeal involvement and those who relapsed, the *Vi* precipitinogen was either found to be absent or present only in traces at irregular intervals. A fair idea could thus be obtained as to where serological interference with convalescent serum was necessary in cases of typhoid fever.

In the absence of any method by which the potency of a therapeutic convalescent typhoid serum could be assessed, the application of the typho-precipitin reaction gave valuable information as to the suitability or otherwise of the serum of a particular convalescent, the period of convalescence at which the most potent serum was available and its dosage in different types of complications.

Since these experiments proved that active rather than passive immunization resulted from this form of serum therapy, convalescent serum was tried as a prophylactic antityphoid measure. No negative phase was observed, the *Vi* antibody forming within a period of 48 hours. There was no rise of temperature and no localized or generalized after-effects. In view of the general experience that *T.A.B.* vaccine inoculation gives rise to very little *Vi* antibody formation, these results can be considered to be encouraging from the immunological point of view.

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Demonstration of the *Rh*-Factor in the Blood of a 48-mm. Embryo

Landsteiner and Wiener[1] described a new antigenic factor, *Rh*, present in 85 per cent of human erythrocytes. This factor they detected by means of agglutination reactions with a suitably absorbed serum obtained by immunizing rabbits and later guinea pigs with *Macacus rhesus* cells.

Human sera containing anti-*Rh* agglutinins and mainly obtained from mothers giving birth to children affected by hæmolytic disease may also be used as typing reagents.

These latter are more suitable since in certain cases they are very potent and obtainable in relatively large quantities. Typing of adult cells with such sera gives clear-cut agglutination reactions.

It was found that the blood of a 48-mm. embryo approximately eleven weeks old could readily be typed (see accompanying table). The agglutination reaction between this blood and potent anti-*A* immune rabbit serum* was very weak, and this relative difference between the strength of the reaction with this serum and human anti-*Rh* sera may indicate that the factor *Rh* develops relatively early in fœtal life.

TITRATIONS OF FŒTAL CELLS WITH HUMAN ANTI-*Rh* SERA AT 37° C.

	Serum				
Cells	1	2	3	4	Anti-*A*
Fœtal	1 : 16	1 : 32	1 : 1	Neg.	1 : 1
Adult	1 : 512	1 : 512	1 : 8	1 : 16	1 : 128

F. STRATTON.

Regional Transfusion Service,
Royal Infirmary,
Manchester.
Sept. 11.

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* I wish to thank Dr. Langley for preparing the rabbit serum.

[1] Landsteiner, K., and Wiener, A. S., *Proc. Soc. Exp. Biol. and Med.*, **43**, 223 (1940).

Infection of Laboratory Animals with Johne's Disease and Leprosy

ACCORDING to Francis[1], "until recently it was generally accepted that laboratory animals had not been infected with *Myco. lepræ* or with *Myco. johnei*". As regards the latter organism, in 1913 five out of twenty-three rabbits, six out of forty mice and three out of twelve rats were successfully infected[2], the disease in three of the mice extending from the stomach to the rectum. In some situations even the muscular layer was invaded by the specific micro-organism, although the majority were found in the apices of the villi. The bacteria were grown on F. W. Twort's *Myco. phlei* egg medium or acclimatized to grow on ordinary glycerine-beef broth, although admittedly it would probably have been better to use naturally infected bovine gut. It was easier to infect by injection than by feeding, but by the latter method infection of the mesenteric glands was not at all difficult, although, of course, this does not mean that intestinal disease would have followed had the animals been allowed to survive.

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Sussex.

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[1] Nature, 152, 250 (1943).

[2] *Vet. News*, Jan. 24, 1914.

In the corrected proof of my article, which unfortunately, owing to my absence on leave, did not reach the printers until the article was in press, I had altered the phrase to which Mr. Twort objects to read, "it was generally accepted that laboratory animals could not be infected with *Myco. lepræ* or with *Myco. johnei*". This correction was made in the reprints. In my original paper[1], I gave a summary of Twort's work but also referred to subsequent experiments which had led workers "generally to accept that laboratory animals could not be infected with *Myco. johnei*". Owing to the almost complete failure of the subsequent experiments, it has not been possible to study Johne's disease in laboratory animals. It is hoped that by the use of very young animals this will now be possible.

John Francis.

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[1] *J. Comp. Path.*, 53, 140 (1943).

Propagation of Potatoes

It is interesting in view of the recent correspondence[1,2] on this subject to recall that a century ago the planting of whole tubers was by no means the only method employed for propagating the potato. Louden ("Encyclopaedia of Agriculture", 1844) lists the use of small cuttings, sprouts, shoots, eyes, and buds, as methods of propagation, and in "Encyclopaedia of Gardening" these and other methods are described. The following notes are based on descriptions given in the 1871 edition of "The Encyclopaedia of Gardening", although, so far as can be judged from the preface, they are likely to be identical with descriptions given in the earlier (1834) edition.

Cuttings were made of young stalks or branches, 5–6 in. in length, in May or June and struck in showery weather in the open or under a hand-glass or in pots. Layers were made in June or July when the potato stalks were 1–2 ft. long, and after layering, these shoots, according to Louden, emit roots at every leaf and produce full-grown potatoes the same year. Suckers may be removed in June, with a few roots attached, and planted carefully when, like layers, they will produce a late crop of tubers.

In seasons of scarcity the sprouts generally found on store potatoes in spring may, when carefully planted in loose well-prepared soil, be made to yield a crop. Propagation by portions of tuber is, according to Louden, the only method fit for general use. He writes: "In making the sets or sections reject the extremes or watery end of the tuber as apt to run too much to haulm, and having the eyes small and in a cluster. Reject also the root or dry end as more likely to be tardy in growth and as according to some producing the curl. Then divide the middle of the potato so as to have not more than one good eye in each set. Where the potato scoop (described and figured in 'Encyclopaedia of Agriculture') is used, take care to apply it so that the bud or eye may be in the centre of each set which this instrument produces of a semi-globular form. The larger the portion of tuber left to each eye, so much the greater will be the progress of the young plant. The scoop is only to be used in seasons of scarcity when the portion of tuber saved by it may be used for soups for the poor or for feeding cattle."

L. G. G. Warne.

Botany Department,
The University,
Manchester. Sept. 29.

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[1] Polunin, N., Nature, 151, 421 (1943).

[2] Bates, G. H., Nature, 152, 135 (1943).

Future of Technical Colleges

The attention of the Council of the Association of Technical Institutions has been directed to the letter on the above subject by Dr. H. Lowery.

The Council is much concerned at some of the statements which are made in that letter. These statements give a very inaccurate picture of the work done by the technical colleges at the present time, and it is doubtful whether in the majority of cases they would ever have been true. In those technical colleges where degree courses are undertaken they are certainly not in any way of a makeshift character, and it would be untrue to say that they have grown out of a makeshift system. In many of the larger technical colleges the staff and laboratory equipment compare most favourably with those of the universities, and not only are the numbers of students comparable, but also the results obtained are academically excellent. The numbers of students taking honours degree courses of the University of London in the technical colleges of the country are quite comparable with those in the internal colleges of the University itself, and it must be remembered that the term 'external' has now quite changed in significance, since the technical colleges working for London degrees are inspected by representatives of the universities and only offer degree courses after full approval by the University has been given.

There is much in Dr. Lowery's letter with which we should very heartily concur, but there would appear to be no useful purpose served by deprecating the outstandingly excellent work on the degree side which many technical colleges have undertaken for some time now, and it is particularly unfortunate that in submitting the evidence to support his case, he should have used statements so far from the truth.

H. Schofield.
(Hon. Secretary.)
H. Garratt.
(Chairman of the Council.)

Association of Technical Institutions,
Loughborough College.
Oct. 2.

GEOGRAPHICAL DISTRIBUTION OF *Arenaria humifusa* Wahlenb., NEW TO THE FLORA OF SPITSBERGEN

By DR. NICHOLAS POLUNIN

Fielding Herbarium, University of Oxford

OF outstanding interest, and the subject of much controversy, is the tiny boreal caryophyll now generally known as *Arenaria humifusa*. It was described as a species by Wahlenberg[1] so long ago as 1812, but afterwards became more widely known as a supposed sub-species or variety or even mere *forma* of *Arenaria ciliata* or *A. norvegica*—or, latterly in America, as the full species *A. cylindrocarpa* Fernald. In 1935 Prof. Rolf Nordhagen[2], after having gathered together (as he used to say) "a very great material" of it, resurrected the designation *Arenaria humifusa*; this is probably the correct one, material from the two sides of the Atlantic being apparently identical and moreover showing a similar range of variation, for example, in habit and pubescence[3].

But the bulk of Nordhagen's much cited book[2] "Om *Arenaria humifusa* Wg. og dens betydning for utforskningen av Skandinavias eldste floraelement" is concerned, as the title implies, rather with discussions of the distribution and historical-phytogeographical significance of the plant, which had already attained some fame in this connexion through the attention of Prof. M. L. Fernald[4], and has since been thus cited very widely, for example, by Abbe[5], Hultén[6], and others, including Fernald, who recently styled it[7] "the famous relict of northern Europe". The rather attractive and soon popular contention was that with some other plants of 'senescent' or 'conservative' (as opposed to 'aggressive') tendency, colonies of *Arenaria humifusa* had persisted in isolated areas which had been ice-free 'nunataks' throughout at least the latest Pleistocene maximum and had survived there, or at least near, until the present day. Meanwhile, examination of one of these 'refugia' by Abbe[5] having brought forth rather conflicting evidence, Raup[8] and Wynne-Edwards[9] tended among others to be at least reserved in their judgment, the last-named putting forward an alternative hypothesis.

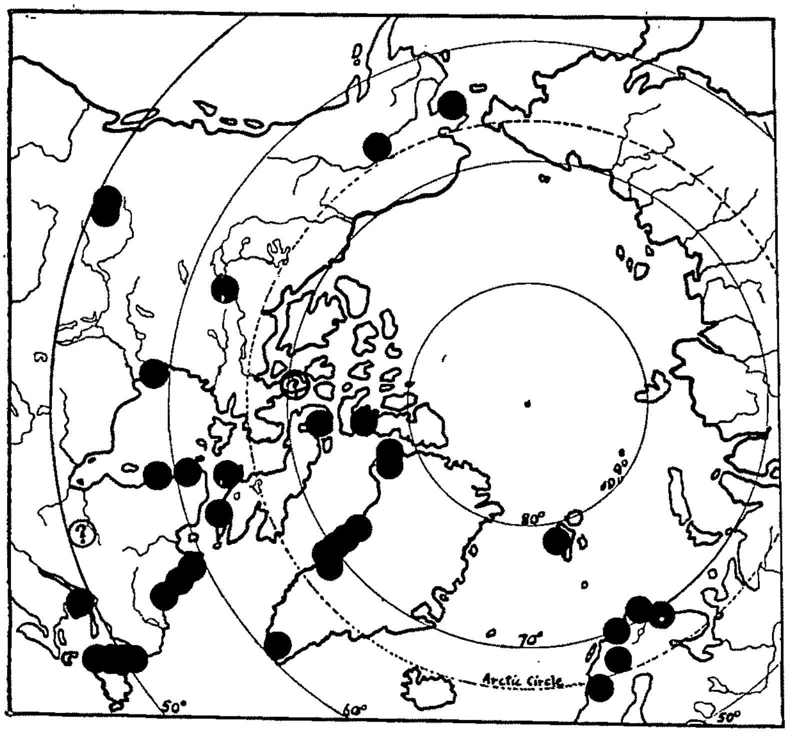
I am not myself prepared at present to enter the controversy, though I would like to see it stimulated to an early conclusion. On one hand I have observed enough plants growing successfully near to, or even on nunataks within, present-day glaciers even in the far north to believe that such 'persistence' is a distinct possibility, while on the other hand I cannot help recalling that substrate and the lack of competition may be of great importance respectively in determining plant populations locally and in aiding ecesis, that migratory birds as well as plants have their own habitat preferences, that a single disseminule carried by any one of all the birds migrating in a millennium (so to speak) "would be sufficient to stock a country or island with any given plant"[10], and finally that "sea ice . . . forms a splendid field for the transport of wind-borne seeds and fragments of plants"[11] particularly of coastal habitats.

Meanwhile, the case of *Arenaria humifusa* may yet present no serious problem, but may help in general clarification: for its actual geographical range is very different from what Nordhagen[2] and others took it to be from the facts to which they had access. Thus I have myself found it in so many regions where it was supposed to be absent that it now seems unnecessary to consider its range as disrupted in the north except by aquatic and other wholly unsuitable substrates. Rather was it the extremely diminutive stature and insignificant nature of the plant, coupled with its somewhat exacting habitat requirements[12] (it appears to be calciphilous and unable to withstand competition, hence most frequent near shores and on mountains), that led to its being extensively overlooked. Given suitable conditions it is able to spread well enough; indeed, the greatest number of individuals of it that I have ever seen at all close together grew (in 1934 and 1936) on the open calcareous gravel of the recently constructed railway and settlement of Churchill, Manitoba, on the west coast of Hudson Bay, where the country is flat for very many miles around.

Now to the 'total distribution' as given by Nordhagen[2], and as generally known in 1935, we can already add the following *regions* (as opposed to minor stations which are of course more numerous): Alaska—west coast and mountainous centre[13], subarctic North-West Canada[14], subarctic Hudson Bay—both east and west coasts[15], Canadian Eastern Arctic—four additional regions[12], South-West Greenland[16], and finally Spitsbergen.

This impressive series of additions from widely separated areas in the last few years suggests that, apart from Iceland and East Greenland and the northern parts of the Canadian Western Arctic, which are quite inadequately explored, and where the species may well occur, it can be considered as generally distributed across arctic and subarctic (climatically delimited) Europe and America right to the extreme west of Alaska. Its distribution to the south may admittedly be somewhat disrupted, but it seems at least as likely that this is bound up with the progressively fewer 'open soil' and otherwise suitable habitats in that direction as that it is dependent upon glacial history, though to be sure we still have to answer the provoking question of how the plants got there. Meanwhile, much support for some 'persistence' seems to be derivable from the study of endemics[4].

The Spitsbergen record of *Arenaria humifusa* is deserving of comment as it has not previously been published; it is the newest and perhaps the most surprising of all. Very recently Mr. A. J. Wilmott and I were revising in the British Museum some material which I had collected in Kongsfjord (Kings Bay, *c.* 79° N. on the west coast of the main island) more than a decade ago and found, in a pile of sheets provisionally labelled "? *A. Rossii*", and which incidentally included several specimens of *Arenaria uliginosa* Schleich. apud Lam. which had only once previously been confirmed from Spitsbergen[17], one which obviously belonged to *A. humifusa* (it was nothing like the locally common *A. ciliata* var. *pseudofrigida*), being practically inseparable in all visible characters from material from Finmark so determined by Prof. Nordhagen and also from material from Newfoundland collected and determined by Prof. Fernald as *A. cylindrocarpa*. Arrived back at Oxford I found among my own unmounted and still not worked up material a duplicate of the same number (152 from the vicinity of Ny-London, a largely limestone district on the north shore of Kongsfjord); apart from the variable characters mentioned above and others which were not always visible, this specimen checked wholly with my Canadian



DISTRIBUTION OF *Arenaria humifusa* WAHLENB.

Eastern Arctic and subarctic material approved by Prof. Fernald and also with my south-west Greenland specimens[16]. Indeed, *A. humifusa* is a highly characteristic little plant that cannot well be mistaken for any other, at least in the Arctic. Its total distribution at present known is indicated on the accompanying map ; but it seems safe to conclude that some entirely fresh regions and many new stations will be added in the future, further to warn phytogeographers against *assuming* absence of a species until proper search (which still can scarcely be absolute) has been made. New regions may even include the British Isles, where, especially in the Hebrides and Scottish Highlands, many interesting northern plants have southern 'outposts'.

There remain among doubtful reports three which appear to be supported by specimens : (1) "Lake Mistassini (J. M. Macoun)" upheld by Robinson[18] and Nordhagen[2], and which the former, always a cautious student, probably saw, for he cited "*A. ciliata*. . . . Var. (?) *humifusa*. . . . *A. humifusa* Whlb. . . ." from "Mt. Albert, Gaspe, *Allen, Porter* ; Lake Mistassini, *J. M. Macoun*, and what is with scarcely a doubt the same thing at Kicking Horse Lake in the Rocky Mts., *J. Macoun*. (Greenland, N. Europe)". I have strong suspicions that the basis of the report by the younger Macoun[19] of *Stellaria humifusa* Rottb. from Lake Mistassini, where he and A. P. Low collected in 1885, belongs in reality to *Arenaria humifusa*, as the two plants might easily be confused and, moreover, this lake is an inland, freshwater one around the margins of which it would amaze me to find the habitually halophilous *Stellaria humifusa*. Meanwhile, be it noted that confirmation of this station would go a long way towards filling the apparent 'gap' between Hudson Bay and the Newfoundland and Gaspe 'outposts' to the south-east. Next we have (2), the specimen in the British Museum from Sir John Ross's second voyage, cited by Simmons[20] and afterwards by Nordhagen[2] as most likely from Boothia Felix. Although the expedition spent much time in that region, where the plant may indeed be expected to occur, they also visited points in the Holsteinborg district of West Greenland[21] where *Arenaria humifusa*, even if it has not yet been found, probably grows (it is "rather common" not far to the north[22] and also occurs to the south[16]), while on the voyage home they camped on beaches in the limestone region of northern Baffin not very far from Arctic Bay, in the vicinity of which I have found the plant several times on similar calcareous terrain near the sea. As we have no known means of telling whence this specimen from Ross's second voyage came (for unfortunately it lacks any indication as to locality, collector, or even date) it seems wisest to mention it only with a strong query. Finally (3), the report by Schischkin and Knorring probably refers to the well-known station on Fiskerhalvøen[2], even if these authors give it as Karelo-Lapland rather than the 'arctic belt' (see maps and lists at beginning of Komarov's Fl. U.R.S.S. series). Meanwhile, it seems remarkable for a plant elsewhere so widespread that there should be only the one known station in all Russia, the whole of Siberia being apparently excluded from its range, although the plant is known to extend virtually from westernmost Alaska eastwards around the remaining more-than-half of the polar cap.

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[1] Wahlenberg, G., "Flora Lapponica" (Berlin, 1812).

[2] Nordhagen, Rolf, *Bergens Museums Arbok*, Naturv. rekke, No. 1 (1935).

[3] Schischkin, B., and Knorring, O., in Komarov, "Flora U.R.S.S.", 6, 517 (1936).

[4] Fernald, M. L., *Mem. Amer. Acad. Arts and Sciences*, **15**, 239 (1925) ; *Rhodora*, **28**, 79, 213 (1926), **35**, 265 (1933).

[5] Abbe, Ernst C., *Rhodora*, **38**, 102 (1936).

[6] Hultén, Eric, "Outline of the History of Arctic and Boreal Biota during the Quaternary Period" (Stockholm, 1937).

[7] Fernald, M. L., *Rhodora*, **44**, 114 (1942).

[8] Raup, Hugh M., *Bot. Rev.*, **7**, 147 (1941).

[9] Wynne-Edwards, V. C., *Trans. Roy. Soc. Canada*, Ser. III, **31** (V), 33 (1937) ; III, **33** (V), 35 (1939) ; cf. Griggs, R. F., *Bull. Torrey Bot. Club*, **67**, 575 (1940).

[10] Ridley, H. N., "The Dispersal of Plants Throughout the World" (Ashford, Kent, 1930).

[11] Ostenfeld, C. H., *Kgl. Danske Vidensk. Selsk. Biol. Medd.*, VI, **3**, 1 (1926).

[12] Polunin, Nicholas, "Botany of the Canadian Eastern Arctic, Pt.1" (Ottawa : National Museum of Canada, *Bull.* No. 92 (1940)).

[13] Porsild, A. E., *Rhodora*, **41**, 141, 199, 262 (1939).

[14] Raup, Hugh M., *J. Arnold Arb.*, **17**, 180 (1936).

[15] Polunin, Nicholas, Ottawa : National Museum of Canada, *Bull.* (in preparation).

[16] Polunin, Nicholas, *J. Linn. Soc. London*, **52**, 349 (1943) ; *Proc. Linn. Soc. London*, Session 154, 118 (1943).

[17] Scholander, P. F., *Skr. om Svalbard og Ishavet*, No. 62 (1934).

[18] Robinson, B. L., *Proc. Amer. Acad. Arts and Sciences*, N.S., **21**, 273 (1894).

[19] Macoun, James M., Geol. and Nat. Hist. Survey of Canada, Annual Report (New Series), I, 36D (1886).

[20] Simmons, H. G., Rep. Second Norwegian Arctic Expedition in the "Fram" 1898–1902, No. 2 (1906) ; *Lunds Univ. Arsskr.*, N.F. Afd. 2, **9**, No. 19 (1913).

[21] Ross, Sir J., "Narrative of a Second Voyage in Search of a North-West Passage, and of a Residence in the Arctic Regions during the Years 1829, 1830, 1831, 1832, 1833" (London, 1835).

[22] Porsild, M. P., *Medd. om Grønland*, **58** (1920).

SENSITIVITY OF THE EAR

THE difficulty in securing accurate values of the minimum stimulus that the ear can detect is reat. In the first place there are differences in the earing mechanisms of various individuals tested. xcept for those with some definite hearing defect, iese differences largely depend on age ; as one rows older the response of the ear becomes less, hiefly at the higher frequencies. Measurements of inimum hearing stimulus thus vary with the age f those being tested. Another difficulty is in measurig the minimum stimulus. According to an article y W. A. Munson (*Bell Lab. Rec.*, 21, No. 10 ; June 943) two references have been widely used. One is ie rms. pressure of the sound wave at a point in a ee sound field where the listener's ear will later be laced. This is the simpler of the two, and is parcularly applicable to studies of the usual mode of earing, that is, without the use of telephone receivers similar devices. The other is the pressure at the ar-drum. This reference avoids uncertainty as to ow the pressure, measured in the air previously to e listening test, would be modified at the ear-drum y the head and ear of the listener, and is particularly seful in studying the mechanism of hearing. It volves great technical difficulties, however, since e space in front of the ear-drum is small and almost accessible.

Regardless of which of these two methods is used, e pressure involved is very minute—less than 1,000 dyne/sq. cm. A pressure of this order of agnitude distributed over the ear-drum results in a rce of the order of only $1/10^8$ oz. As an organ for tecting pressure changes, the ear is thus far more nsitive than our tactile organs, since a touch of this ghtness would be imperceptible. Even at the upper nit of hearing, the force is only some thousandths an ounce. Vibrating pressures greater than this come tactable rather than audible and result in e sensation of pain. Any air wave with an rms. essure above the threshold value enters our conciousness as sound, and the sound becomes louder e higher the pressure. Since it is the loudness ther than the pressure that we are directly conscious , some scale for measuring loudness is also desirable.

The results of a large amount of work were summarized some years ago by Fletcher and Munson and was decided to use the loudness of a 1,000-cycle ne as a reference. This frequency is widely used a test tone throughout the Bell System, and it has e advantage of being very close to the frequency nge for which the ear is most sensitive. Since in neral the relationship between the magnitude of a nsory response and its stimulus is logarithmic, it emed desirable to use a logarithmic scale, and for nvenience the loudness-level of a 1,000-cycle tone as arbitrarily taken to be the intensity level. oudness-level at any other frequency or combination frequencies is taken to be equal to the intensity-vel of a 1,000-cycle tone that sounds equally loud. lthough loudness-level is measured on a logarithmic ale, and thus corresponds in magnitude to a decibel ale, the unit is called a phon instead of a decibel indicate that the thing measured is basically fferent from power.

At 1,000 cycles the threshold of hearing in a free ld is just about at 0 intensity-level, which also stifies making the loudness-level and intensity-level ual by definition at this frequency. At 1,000 cycles, erefore, an increase in intensity-level results in an equal increase in loudness-level. This equality is found not to exist at other frequencies, however.

To the question : How little do we hear ? the only safe answer is : it all depends. What we hear is a sequence of periodic pressure changes in the air, but how small the pressure changes may be, given a normal young ear, depends on the rapidity of the changes. The ear is most sensitive when the pressure cycles are occurring at rates between 1,000 and 5,000 times per second, since we can then detect changes of less than a thousandth of a dyne/sq. cm. At both higher and lower frequencies, the sensitivity falls off. The studies that have determined these minimum perceptible pressure changes, and the many others that have established units of measurement and adequate techniques and apparatus, have provided the foundations for the extensive studies of hearing that have been carried on in the Laboratories.

CERAMICS FOR HIGH-FREQUENCY INSULATION

ACCORDING to an article by M. D. Rigterink (*Bell Lab. Rec.*, 21, No. 9 ; May 1943) electrical porcelains which are satisfactory and useful materials for low-frequency currents have been replaced for high-frequency currents by new ceramic materials which have far smaller power factors. This replacement becomes absolutely essential at elevated temperatures such as are encountered in power vacuum tubes in which the insulator operates almost red hot. The power factor of most ceramics increases very markedly with increase in temperature, this causing more conversion of electrical energy into heat and producing a cumulative effect which may lead to a breakdown in any but the very best materials.

The most widely used of the improved ceramics are the steatites, this term now being applied to all synthetic ceramic materials which are prepared with talc as the principal raw material and which have magnesium metasilicate as the principal crystalline phase. Steatite bodies are prepared from mixtures of 60 per cent or more talc, 30 per cent or less kaolin, and the remainder usually of alkali or alkaline earth oxides or compounds that will decompose to give these fluxing oxides. The formed ware is heated from 1,200 to 1,400° C. on a controlled heating and cooling cycle. During this heat treatment the fluxing oxides combine with part of the magnesia, alumina, and silica given by the talc and the clays to form glasses which in turn dissolve more of these constituents as the temperature rises. In addition to glass formation, chemical reactions take place between the solids and between the solids and liquid glasses ; crystallizations also occur as the temperature is lowered, and finally crystalline transformations are produced. These complex changes cause the mixture to shrink and to become the hard, dense material known as a steatite ceramic.

Dielectric properties of the steatite ceramics vary considerably, depending on the amount, kind and proportions of fluxing oxides that are used in their preparation. The alkalis are particularly detrimental, and the alkaline earth oxides appear to be especially beneficial. Other variations are caused by the grinding and mixing of the raw materials, the firing cycles, and the nature and the amount of impurities present. All the steatites have unusually high transverse, tensile, and compressive strengths, these values frequently being as much as three times as high as the corresponding values for electrical porcelains. They also possess resistance to cold flow, ability to withstand high temperatures, resistance to all common chemical agents except hydrofluoric acid, and low porosities.

Steatites have replaced porcelains for some uses solely because of their greater mechanical strength but more frequently on account of their improved dielectric properties. The useful range of dielectric constant for steatite ceramics varies only from five to eight. Loss of electrical energy in these insulators depends more on the power factor than on the dielectric constant.

Another interesting and important property of these steatite ceramics is that those which have good insulating properties for direct current may not be as satisfactory for alternating current. For example, ceramic bodies with the same direct current resistances were prepared for which the values of tan δ at 100 kc. varied by a factor of more than twenty-five. Thus, where a.c. and d.c. voltages are superimposed the dielectric properties for both have to be considered in comparing different materials.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Saturday, October 16

Institute of Physics (X-Ray Analysis Group) (joint meeting with the **Manchester and District Branch**) (in the Physics Department, The University, Oxford Road, Manchester), at 2.30 p.m.—Sir Lawrence Bragg, F.R.S.: "The Physical Optics of X-Ray Analysis"; Short Papers and Exhibition of Apparatus, etc., relating to Industrial Problems.

Association of Scientific Workers (North-West Area) (in the College of Technology, Sackville Street, Manchester).—Sir Robert Watson Watt, F.R.S.: "The Freedoms of Science".*

Sunday, October 17

Association of Scientific Workers (North-West Area) (in the University, Liverpool).—Sir Robert Watson Watt, F.R.S.: "The Freedoms of Science".*

Monday, October 18

Royal Geographical Society (at Kensington Gore, London, S.W.7), at 5 p.m.—Dr. E. C. Willatts: "Physical Names for the Map of Great Britain".

Tuesday, October 19

Society of Chemical Industry (Agriculture Group) (at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1), at 2.30 p.m.—Mr. W. Morley Davies: "Lime in Agriculture".

Institution of Professional Civil Servants (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—The Rt. Hon. Sir Stafford Cripps, P.C.: "Radio and International Relations".

Royal Photographic Society (Scientific and Technical Group) (at 16 Princes Gate, South Kensington, London, S.W.7), at 6 p.m.—Dr. G. W. W. Stevens and Mr. P. C. Smethurst: "High-Resolution Microphotography—Graticules".

Friday, October 22

Institution of Mechanical Engineers (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Prof. F. C. Lea: Presidential Address.

Friday, October 22—Saturday, October 23

Town and Country Planning Association (at the Royal Empire Society, Northumberland Avenue, London, W.C.2).—Conference on "Country Towns in a National Planning Policy".*

Friday, October 22—Sunday, October 24

Institute of Industrial Administration (at the Waldorf Hotel, Aldwych, London, W.C.2).—Conference on "Management in Action".

Saturday, October 23

Sheffield Metallurgical Association at 2.30 p.m.—Discussion on "The Education and Training of Metallurgists" (to be opened by Dr. Edwin Gregory).

APPOINTMENTS VACANT

Applications are invited for the following appointments on before the dates mentioned:

Teacher of Mathematics and General Science for Technical D School and College—The Chief Education Officer, Education Offic Park Road, West Hartlepool (October 20).

Educational Psychologist (full-time)—The County Medi Officer, Public Health Department, Shire Hall, Nottingham (Octo 20).

Assistant Agricultural Chemist—The Principal, Agricultu Institute and Experimental Station, Kirton, Boston, Lincs. (Octo 21).

Teacher of Physics—The Principal, Acton Technical College, H Street, Acton, London, W.3 (October 22).

Lecturer (full-time) **in Physical and Inorganic Chemistry**, a **Lecturer** (full-time) **in Zoology, with Botany or Physiolog** The Clerk to the Governors, South-East Essex Technical College School of Art, Longbridge Road, Dagenham, Essex (October 22).

Lecturer in Mining—The Clerk to the Governors, Techn College, Infirmary Road, Chesterfield (October 23).

Lecturer in General Science for the Junior Technical Colleg The Principal, Derby Technical College, Normanton Road, De (October 23).

Lecturer in Mathematics, and an **Assistant Master** to tea **Science** and subsidiary **Mathematics**—The Principal, Kingston Te nical College, Kingston, Surrey (October 25).

Teacher of Engineering Subjects, and a **Teacher of G graphy**—The Principal, West Ham Municipal College, Romford Ro Stratford, London, E.15 (October 25).

Assistant to the Advisory Mycologist—The Advisory Mycolog School of Agriculture, Cambridge (October 30).

Engineering Graduate (or equivalent qualifications) to te chiefly Mechanical Subjects—The Principal, County Technical Coll Dartford, Kent.

Assistant Engineer for the British Guiana Public Works Dep ment—The Ministry of Labour and National Service, Central (Te nical and Scientific) Register, Alexandra House, Kingsway, Lond W.C.2 (quoting Reference No. E.767).

REPORTS and other PUBLICATIO

(not included in the monthly Books Supplement)

Great Britain and Ireland

Institute of Statistics, Oxford. Supplement No. 5, Bulletin Vo New Plans for International Trade. Pp. 40. (Oxford: Basil Bl well.) 1*s*. 6*d*. net.

Royal Institute of Chemistry of Great Britain and Ireland. Lec on Leather. By Dr. Dorothy Jordan-Lloyd. Pp. 31. (London: R Institute of Chemistry.)

Hannah Dairy Research Institute. Report for the Two Years ing 31st March 1943. Pp. 20+4 plates. (Kirkhill: Hannah D Research Institute.)

Geological Survey of Great Britain. Wartime Pamphlet No. Determination of Tin, with Special Reference to Tin Ores. By C Harvey. Pp. 13. (London: Geological Survey and Museum.) 9*d*.

Imperial Agricultural Bureaux. Report on the Imperial A cultural Bureaux by a Committee under the Chairmanship of Rt. Hon. Lord Hankey. Pp. 38. (London: H.M. Stationery Off 1*s*. net.

Other Countries

Indian Forest Bulletin. Utilisation (New Series), No. 118: Stu in Fire Resistance, Part 1: The Fire Resistance of some In Timbers (a) The Rate of Burning. By D. Narayanamurti and Gopalachari. Pp. 17. (Dehra Dun: Forest Research Institu 6 annas; 9*d*.

Indian Forest Leaflet. Utilization, No. 39: Bamboo Pill or O ment Boxes. By Sultan Mohammed. Pp. 6+1 plate. (Dehra D Forest Research Institute.) 6 annas; 9*d*.

Indian Forest Records (New Series). Silviculture, Vol. 5, No. Teak Plantation Technique. By A. L. Griffith. Pp. 123–220+19 pla (Delhi: Manager of Publications.) 4·2 rupees; 6*s*. 6*d*.

Indian Forest Leaflet. Timber Development Branch, No. River Training Works. By J. L. Harrison. Pp. 11+5 plates. annas; 9*d*. Silviculture, No. 38: Land-Use and Erosion. By damba Prasad. Pp. iii+9. 4 annas; 5*d*. (Dehra Dun: Forest Rese Institute.)

Determinacao quantitativa do aluminio; sua precipatacao por da fenilhidrazina. Pelo Wolfrando Carvalho de Moraes Bastos. 54. (Rio de Janeiro: Instituto Nacional de Tecnologia.)

New Zealand. Seventeenth Annual Report of the Departme Scientific and Industrial Research. Pp. 44. (Wellington: Governm Printer.) 1*s*.

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EDUCATIONAL RECONSTRUCTION (3)

THE NEEDS OF YOUTH

SINCE 1937 the promotion of facilities to enable young persons and adults to use their leisure in a wide variety of activities covered by the general terms 'social and physical training' has been recognized as an appropriate element in the education service. Between that year and the Education Act of 1918, local education authorities had been concerned only with the leisure activities of young people attending some school or other educational institution and under the age of eighteen. An amendment made in 1937 swept away these limitations, and particular attention has since been concentrated on the interests and requirements of young persons who have left school and passed outside the confines of formal training. But the objective of the National Fitness Council, as its name suggests, was only with physical fitness. In throwing out of focus a perception of the general needs of youth, this was a hampering limitation, and this is now recognized in the recent White Paper on Educational Reconstruction.

With the outbreak of war it was felt necessary to maintain and extend the influences which had contributed to the well-being of the young life of the nation. Accordingly, in November 1939, Circular 1486 was issued by the Board of Education empowering local education authorities, in conjunction with the national voluntary organizations, to set up youth committees which could immediately begin to formulate an ordered policy for youth and also suggest lines on which developments might proceed after the termination of hostilities.

Despite the restrictions and difficulties that the War has brought, the service of youth has made considerable progress. To-day, there is a far higher proportion of the young people of Great Britain associated with healthy and recreative leisure-time activities than at any period of our history, although the proportion is still lamentably low.

In order to bring together the ideas and experiences that have been obtained in the youth service since its inauguration, the president of the Board of Education set up a Youth Advisory Council in August 1942 to consider the position of the youth service as a part of the educational system after the War. So that its terms of reference might be clarified, the Youth Advisory Council was asked to assume : (1) that the school-leaving age would be raised to fifteen without exception, (2) that the period from fifteen to eighteen would be treated in some degree as an educational period in the sense that adolescents would be regarded as remaining the concern of the education service, and (3) that a system of compulsory part-time education during working hours would be established for all young persons after they had ceased full-time schooling, up to the age of eighteen.

The members of the Council were drawn from local education authorities, the national youth organizations, pre-service training corps as well as individuals distinguished for their work with young people. In presenting its report*, which, of course, is in no way a statement of considered Government policy, the Council has made a valuable contribution towards promoting a more general understanding of this highly important field of youth service. The report is one to which no summary of its principal conclusions could do justice. To grasp the mixture of hard-headed realism and imaginative understanding which has inspired its originators, the report should be read in its entirety.

The Council has wisely refused to be tied to the precise age-groups which limit the entry of young people to certain organizations but has expressed the wish that, after the War, no age lower than twenty will be accepted as the appropriate upper limit to the youth service. Only by thinking of a boy or girl as a whole person, with a past and future as well as an adolescent present, can the subject be seen in proper perspective. It is with this 'wholeness' of life in mind that the Council begins its report with some comments on homes and families, the national system of formal education, religion in youth activities and the quantity and quality of work which young people are called upon to do.

Warm tribute is paid to the enthusiasm and endurance with which young people have met the challenge of war, and the belief is expressed that they will respond as courageously to the challenge of the post-war world if they are given a careful and thorough training for citizenship. To make this possible, certain conditions will have to be fulfilled. Thousands of young people have to live in surroundings which make it almost impossible for them to become good citizens. This scandal must be removed at the earliest possible moment. No fitter comment on this situation could be found than one written by Dr. A. E. Morgan in "The Young Citizen". "There is no reason why the environment of a working lad in his leisure hours should be inferior to that of a university undergraduate."†

It is part of the policy of H.M. Government to raise the school-leaving age to fifteen without exemption; but the Council recommends that full-time attendance at school up to sixteen years of age should be aimed at as soon as conditions permit. Up to the age of eighteen the first call on the working day should be education; the transition from full-time schooling to full-time employment should be a longer and more regulated process. Continued education must be regarded not as a concession granted by the employer but as a right given by the community. During the later years of compulsory school attendance, a wider variety of activities should be encouraged. The provision made for education for industry, and particularly for technical education, is inadequate and should be considerably expanded. Any raising of the school-leaving age would imply compulsory maintenance grants or allowances.

In the choice of employment service, existing arrangements are irregular and spasmodic. Young persons ought to be able to enjoy the benefit of expert advice given in the light of the individual' aptitudes and in conformity with the best moder methods of vocational guidance and selection. Loca education authorities, employers, organized labou and the Ministry of Labour should unite to enabl all young people and their parents to obtain skille industrial guidance, both on first entry into employment and afterwards. Choice of employment power should be made a statutory obligation of the loca education authority, and until the law is altered t this effect, advisory committees under the administration of the Ministry of Labour should includ members of the local education authority as well a members of the local youth committees.

Hours of work are too long. During war-time n boy or girl under sixteen should work more than maximum of forty-four hours weekly; for thos between sixteen and eighteen the maximum shoul be forty-eight hours. As a permanent peace-tim regulation the permitted maximum for all up t eighteen should be forty-four hours inclusive of part time school. Overtime and the accompanying hig wages present grave social dangers which are likely t persist until a greater sense of responsibility can b fostered in the young people themselves. The qualit of work, too, is often as objectionable as the quantity If there is no solution of this problem inside workin hours, increase in the amount of a young worker' leisure is necessary and urgent. The imperative nee inside industry is to restore to every kind of work tha sense of social significance which has largely bee lost as machines have replaced men. Any tendenc in the youth service towards the 'academic' in education should be resolutely opposed.

It is impossible to segregate religion from oth activities; it must form the background of home school, work and leisure alike. The Council is co cerned to see preserved, or born, a genuinely Christia civilization, one whose members are not all necessaril professing Christians but one in which the Christia belief in God and all that is consequent upon it f human liberty and brotherhood, the Christ-like ide of life, and the preservation of the fundamental idea of truth, goodness and beauty, set the tone f society. Religion is a positive need for young people the Council insists that it is nothing more than the due that religious opportunities should be provide Such opportunities must, of course, be of varyin character in order to satisfy not only the mult plicity of needs of the children but also the man demands of the parents. For religion is of such a pr foundly personal character that any semblance regimentation or any attempt at bringing abo homogeneity are bound to prove failures.

With this background clearly outlined, the repo goes on to discuss the fundamental problem of t right use of young people's leisure. Here it is of fir importance to start from the point of view of th young people themselves and not from the angle what the various agencies concerned can contribu to what they consider to be the right use of leisu In emphasizing the wholeness of life, the Coun here brings out what is probably its most importa recommendation, namely, that unless we wish to re a people incapable of exercising its freedom, there must be preserved a part of life in which young people should be left free to choose their leisure activities. These should not in any way become the subject of compulsion, and the greatest variety of opportunities for the right use of leisure should be provided. This recommendation is fully borne out by some research carried out for the Workers Educational Association during 1934–37 into the activities of youth organizations. The chief characteristics of young people inside these organizations were reported to be: (1) a dislike of externally imposed discipline, (2) a dislike of organization and complex loyalties, and (3) a severe code of discipline imposed from within the organization on members themselves and backed by open criticism and imposition of standards. Everyone is familiar with the boy or girl who is not by temperament attracted to communal activities and who finds the life of a club or any other organized body of their contemporaries overwhelming and uncongenial. In war, as in peace, it is undesirable to apply compulsion to the leisure hours of young people.

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* The Youth Service after the War. (H.M. Stationery Office, 1943.) 6d. net.

† Young Citizen. (A Penguin Special.) P. 178.

Further, the leisure hours of young people are so few that at first sight the whole paraphernalia of the youth service seems irrelevant and undesirable. So ong ago as the year *c.* 38, Ecclesiasticus wrote that "the wisdom of a learned man cometh by opportunity of leisure", and it is time that this truth was fully apprehended.

Even more harmful than the excessive hours of work is the usual practice of limiting to one week the annual holiday of the working boy or girl. Despite the many difficulties that would arise, the community as a whole would benefit if all young workers could enjoy an annual holiday long enough to give them a real opportunity for recreation. A minimum annual holiday of twenty-four working days (inclusive of the ix statutory holidays) is suggested, twelve of the days o be consecutive. Facilities and opportunities for the proper enjoyment of these holidays should be made available. To meet the needs of young people n their daily leisure, the work of voluntary rganizations and statutory authorities should be trengthened and extended.

The youth service should operate to lead young people towards adult life; the fitful demand of adolesence is its desire to achieve maturity. The separate 'youth centre' with the buildings of the day continuation school (or young peoples college) as its physical nucleus cannot be regarded as ideal for this purpose, and it is suggested that statutory authorities in providing communal premises for youth work should lan them as part of adult community centres. This s essential to the process of guiding youth through the "delicate weaning stage from childhood to adulthood; from subjective dependence to objective independence; and if it is to be introduced to the main business of life, which is the attainment of the fullest elf-expression, fraternally, economically, politically and spiritually."*

So that we may be prepared, provision should now e made for Great Britain as a whole, as part of educational reconstruction after the War, of facilities in town and country for educational, social and physical recreation.

When the youth service scheme was announced in November 1939, it was realized that the relation between the statutory authorities and the voluntary organizations might prove the stumbling-block to progress. Good will has pushed the stumbling-block aside and it has been proved that both have a part to play and that their respective contributions are essentially complementary. In the near future the problem of the statutory authorities in youth service work will become more pressing and their responsibilities greater. As these responsibilities increase, they will do well to remember that it was through the ideals and enthusiasm of the voluntary organizations that the first work for adolescents was undertaken, and that the policies and programmes of the voluntary organizations have been built on well-tried experience.

To make their much-needed contributions, the voluntary organizations must be strengthened financially; any scheme devised for this purpose should be flexible and so administered as to encourage free development. Extension of the help which the voluntary organizations now receive from public funds should be accompanied by some measure of public control over their activities. This could be done without interfering with the development of the organizations, if they issued periodical reports, published headquarters accounts, and submitted their finances to the scrutiny of the Board of Education. Where a local education authority gives local grant-aid to a voluntary organization, the authority, as well as the Board, should have the right of informed inspection.

This measure of control is not likely to meet with serious opposition from the majority of the voluntary organizations. One or two may object to any measure of public control and look aghast at what they consider to be the sinister approach of bureaucracy. For their part they must realize that many individuals who serve the voluntary organizations and have considerable power in their deliberations and pronouncements are as much paid servants as the officials of the statutory authorities. It may be that of late too much emphasis has been placed on the word 'voluntary' and that the time has come when at least some of these national organizations recaptured the spirit of service which animated their founders and which has meant so much to the welfare of the community.

The growth of the pre-service cadet corps has been so rapid that to-day they comprise a large proportion of the total number of boys who belong to a youth organization. Their development has been greatly helped by the considerable financial assistance given to units by the Service Departments. This assistance is related to the needs of war, and it is far from certain that, when the pressing needs of war are past, the Service Departments will be prepared to subsidize cadet work to anything like the extent to which they do to-day. Moreover, the motives which lead boys to join the corps in time of war will have lost much of their force. If the corps are to continue in peace to play any considerable part in the youth service, they must greatly develop the educational, social, and recreative side of their work. This suggests that the general responsibility for their administration, direction and finance should be turned over to the Board of Education and the local education authorities. At the same time it is essential that the Service Departments should prescribe and retain the supervision of both the content and the standards of the pre-service training.

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* "Adult Education", *Quart. J. Brit. Inst. Adult Educ.*, 26 (Septemr, 1941).

The position of the National Association of Training Corps for Girls differs materially from that of the boys' pre-service training organizations. While it provides a certain amount of general pre-service training, it is not attached to any one branch of the Armed Forces and has never been under the control of the Service Departments. It is presumably an organization which, by the provision of a general type of training, offers to girls the opportunity of voluntarily continuing their education irrespective of a specific objective. It is desirable that the National Association of Training Corps for Girls should continue in existence after the War as a uniformed organization. The Board of Education and the local education authorities should extend to it the same degree of support as is given to other voluntary organizations.

The youth committees which were set up after the issue of Circular 1486 differ from one another both in constitution and efficiency. The essential qualification for membership is youthfulness, if not in years at least in spirit. It is far from certain that this 'young-mindedness' has been sufficiently insisted upon. Taking the broad view, however, the experiment of laying joint obligations on the local education authorities and the voluntary organizations has been successful, and the co-partnership needs increasing to the fullest possible extent. After three years of experiment, a useful function would be served if the Board of Education collected and issued for the guidance of all youth committees the information which by now must be available about the ways in which this very practical form of education in citizenship has developed.

The Council's broad survey of the field of youth is important for the emphasis it lays on the 'wholeness of life'. The home, school, employment, leisure, service and religion all interact for the development of intellect, skill, personality and character, and the Youth Advisory Council has wisely insisted that the whole upbringing of a boy or girl shall be in the widest sense educational. This is all to the good, for frequently do we end our arguments concerning the various failings of present-day youth—from lack of social sense to that of musical appreciation—with the everlasting demand, education and more education. By their challenging and long-sighted recommendations in the interests of youth, the Youth Advisory Council, fairly representing the opinion of the majority of youth workers in Great Britain, has presented the President of the Board of Education with advice to which he will no doubt pay the closest attention. Much depends upon it.

INDUSTRY AND SOCIETY (I)

RELATION TO THE NATION

A SIGNIFICANT indication of the widesprea
interest in the organization of industry afte
the War and the relations between industry an
government can be seen in the references to thes
questions at recent important company meetings suc
as those of Boots Pure Drug Company, the Associate
Portland Cement Manufacturers and Associated Ele
trical Industries. At the last-named meeting, Si
Felix Pole emphasized the efficiency and adaptabilit
of industry as it is now organized; he leaned toward
a planned organization of the cartel type, much a
Lord McGowan did in a recent article in the *Sunda*
Times on the place of combines and cartels. Thes
and other addresses in the past few months sho
that the place and functions of private enterprise i
the national economy are under re-examination.

Many factors have contributed to this positio
War-time developments and the experience of wa
time controls, the growth of restrictive practices, fo
all their denunciation by industrial leaders of hig
repute, our closer contacts both with Soviet Russi
and with the United States—the recent visit to Grea
Britain of Mr. Eric A. Johnson, president of th
Chamber of Commerce of the United States, ha
demonstrated some important differences in th
British and the American view of creative privat
enterprise—have all played their part, and the gener
point of view has been well put by Mr. Herber
Morrison, particularly in his speech at Leeds in Apri
A case can be made for private enterprise in appr
priate fields, as well as a powerful case for publi
enterprise. There is no case whatever for privat
un-enterprise, or for private control without the sp
of free competition or of real social purpose.

That much will be generally admitted, particularl
by scientific workers concerned with the prosecutio
of an adequate programme of scientific and industri
research as an integral part of post-war plans. Tl
fresh scrutiny of private enterprise to-day, in spite
recognized shortcomings of State control during tl
War in certain directions, is due to the widesprea
appreciation that large sections of British indust
were anything but enterprising in the twenty yea
between the two Wars. Attempts in some reports o
reconstruction, such as those of the Federation
British Industries, the Association of British Char
bers of Commerce, and, to a lesser extent, the stat
ment on "A National Policy for Industry", to glo
over this record, and a timidity of outlook simu
taneously apparent have not allayed this concer
On the contrary, they have stimulated fresh fea
that such important associations are looking
policies of restriction and monopoly destined in t
long run to be as fatal to their own interests as to t
policy of full employment which public opinion,
Great Britain as elsewhere, is coming insistently
demand.

That much clearly emerges from the surv
"Industry After the War. Who is Going to Run It
which Charles Madge has produced as the first of t

"Target for To-morrow" Series*. But neither Mr. Madge in his summary, nor Sir William Beveridge in his introduction, goes any deeper into the fundamental issues than the statements already criticized. The Unilever paper, "The Problem of Unemployment", the more recent Nuffield College paper, "Employment Policy and the Organization of Industry after the War", and the report of the Sub-Committee of the Liberal Party on the relation of he State to industry, it is true, go nearer to the roots of the matter. Even in these, however, no real attempt is made to sort out the fundamental issues and to ask the all-important questions regarding he relations of Government and industry before an attempt is made to define the targets or formulate he lines of policy.

Such fundamental thinking is an essential preliminary, and without it plausible schemes for the self-government of industry are more likely to be snares or delusions than contributions to the solution of the problem of full employment. The fact is, as Dr. A. D. Lindsay points out in his recent volume, "The Modern Democratic State", that industrial or economic organization is not just an instrument; it partly moulds the society which uses it. Some ecognition of this truth lies behind the general belief that the measures open to unregulated and unaided private enterprise will not suffice to vary the incidence of the trade cycle and to maintain a constant and high level of employment, but that a national economic policy is required to deal with cyclical unemployment. Before, therefore, we can determine the right relations of government and industry in a democratic society, we must have clear conceptions ot only of the nature of that society but also of the lace and functions which government and industry are to serve in it. It is the confusion on this point that has darkened counsel in so many of the proposals and discussions on industrial self-government, planning and the public control of private enterprise nd production. The distinction between government nd management is often overlooked and Dr. Lindsay's volume is to be welcomed for its contribution to the clarification of the issues on this point alone— contribution which at least merits comparison with that of Prof. Ernest Barker's "Reflections on Government".

The leadership which industry has failed to supply is an essential in a society in which industry is to be real social function, and the attention which has been directed to this point of late, notably in the statement on "Industry and Education" issued by Nuffield College, indicates that an attempt is being made to meet the need. If democracy is to survive, it will have to employ and use, as Dr. Lindsay truly remarks, every scrap of skill and knowledge and leadership it can secure. "A modern democratic State is only possible if it can combine appreciation of skill, knowledge and expertness with a reverence for the common humanity of everyday people."

That is the conception of equality which democratic institutions must express along with liberty. The function of the State being to serve the community and in that service to make it more of a community, a democratic government must be sensitively aware of the conditions which are making equality and liberty hard to maintain. There are clearly certain minimum rights and minimum standards of economic security which it must provide. But it must also be swift to diagnose and to deal with such obvious and outstanding evils as widespread unemployment, which so poison the life of a people that they make real community impossible.

In a democratic society this cannot be the task of the government only. The government must seek to enlist the help of all those free associations in which the life of society finds expression, and notably is this true of industry. The first step to self-government of industry is not so much freedom from government control as association and integration with the workers themselves. The joint production committees already set up in Great Britain may well be a step in this direction, and with a wise educational policy may so broaden the basis of recruitment that natural leaders are thrown up as they should be, and the closer integration of industry with the life of the community rendered possible.

Whether the joint production committees will provide exactly the type of machinery required to achieve this purpose requires further examination. They should be regarded as an experiment the results of which require study and comparison with those obtained in other experiments, for example, the autonomous groups of M. Dubreuil. Dr. Drucker has suggested a guild structure in industry, and unquestionably it should be one of our prime purposes to develop genuine local self-government in this sphere, to develop as Dr. Drucker urges, in "The Future of Industrial Man", social institutions in industry through which industry can become a functioning self-governing social community.

That would do much, by giving the individual industrial worker social status and function, to arrest the social atrophy which mechanization has often introduced. It would make also a decisive contribution to the establishment of the public confidence on which the Nuffield College statement rightly lays stress. Again, it is linked up with what Dr. Drucker considers the other essential in the establishment of a functioning society, namely, making the decisive social power into legitimate power, or in other words power derived from the consent of the governed. Clearly there is no surer way of gaining public confidence in the conduct of industry than the demonstration beyond question that it is directed to serve the needs of society and not merely the private interests of those who are engaged in it, whether they be investors, management or the workers as such. Misgivings on such points are in fact the main ground of uneasiness at present; they lead to the fear that price-fixing and restrictions on production are determined by considerations of private profit and not of public service and social needs.

The Nuffield College statement on "Industry and Education" does well to stress this factor of confidence, for only by such means can we ensure the full co-operation of workers, management and consumers that is essential both for efficient production in the technical sense and for the service of social needs. In this sense morale is no less important in the normal operation of industry than it is in the war effort. The success of post-war reconstruction policy, and in particular that directed to full employment, depends at least as much upon the standard of morale in industry and in the nation as a whole as does our ability to win the War.

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* Industry After the War: Who is Going to Run It? By Charles Madge, in consultation with Donald Tyerman. (Target for Tomorrow, No. 1.) Pp. 64. (London: The Pilot Press, Ltd., 1943.) 3s. 6d. net.

Given, therefore, that one of our objectives should be to create conditions in which industry has the best chance of developing as a social service, and in doing so develop real self-government and co-operation between management and workers, we can consider the machinery by which that broad objective can best be achieved. If one of the essential functions of the State is to remove the disharmonies which threaten the common life of the community, the more positive and constructive functions which the government is rightly expected to perform make it difficult to draw a clear line between the functions of a modern government and those performed by voluntary associations. The essential problem is in fact to arrive at such a balance between voluntary association and the compulsory organization of the State as will ensure the maximum harmony in communal life while keeping the State as the servant and not the master of the community.

The clue to the right solution here is not hard to find. It is a great mistake to assume that the strength of a government is increased by adding to its powers, because additional powers always impose additional duties. There are tasks which only a central government can perform; and if it is to discharge those tasks well, it is important to devolve on local authorities or even on voluntary associations all the functions they can competently perform. In the decision to centralize authority the *onus probandi* should always rest with those urging centralization.

Much of the present dissatisfaction with the machinery of government in Great Britain can be traced to violation of this principle. Failure to delegate responsibility or authority effectively may well be responsible for the central government becoming immersed—doubtless with all the exigencies of the War in extenuation, if scarcely in excuse—in a mass of detail that has prevented it from considering those broad issues of policy and making the decisions, for example, in regard to land policy, planning and building which are required before local and regional authorities can proceed with the more detailed planning and execution which is their responsibility. The consequences in industry are similar. As both the Nuffield College statement and the Unilever paper show, there are fields in which the Government must announce its decisions and lay down the broad lines of policy before industry can make its own plans, and this is independent of the exact structure of industry, and whether it takes the form of private enterprise or State enterprise. Unemployment, investment policy and exports are all matters of this type where Government initiative, guidance and control are the first requisite.

Unfortunately, Mr. Madge, in his "Industry Afte the War", fails to discriminate between the contro and management of industry. The difference i important. If a measure of public control is adopted for a particular industry, the management of industry in the sense of the technical conduct of its day-to-day affairs must still be efficient. The fears as to Government control are largely due to this confusion between control and management, and its removal must b one of the first steps to secure the effective integration of industry as a social activity, whether from th point of view of securing the co-operation of worker or the confidence of the public in general.

INFANT MORTALITY

Birth, Poverty and Health

A Study of Infant Mortality. By Richard M. Titmuss. Pp. 118. (London: Hamish Hamilton, Medical Books Ltd., 1943.) 7*s.* 6*d.* net.

AMONG indexes of disease and death none offer a more inviting field for research in the fiel of vital statistics than the infant mortality-rate. It distribution among different social classes an different communities has an extremely high disper sion, and the general level within a single composit social group has unique features. While chances o death at other ages declined steadily during the whol of the last three quarters of the nineteenth century both in Britain and in Western Europe as a whol the death-rate under one year of age fluctuated abou the same figure—150 per thousand for England an Wales—until about 1899. From 1900 there has bee a continuous and spectacular change. During th subsequent half-century the number of infant death per thousand in our own country has fallen by mo than sixty per cent. This being so, it is surprisin that contributory social agencies have attracted s little inquiry to date. One reason is a hangov from an ideology widely current in the period whe evolutionary concepts furnished a convenient rationa for an economy of unrestricted private competiti and colonial misgovernment. What Sir Henry Mai called the "beneficent private war which mak one man strive to climb on the shoulders of anoth and remain there" was the prevailing creed of th universities when the existence of differential mo tality first forced itself on public discussion. Foremo among articles of the creed was the postulate th class mortality and morbidity differences have the origin in differences of genetic constitution.

In conformity with a type of non-sequitur endem in writings about what one calls eugenics on th side of the German Ocean and *Rassenhygiene* on th other side of the North Sea, differences which a inborn are also irremediable. By the same toke the probable existence of genes which affect resistan to smallpox would invalidate vaccination, and th certain existence of genes which affect susceptibili to cancer would veto radium therapy; but the were too few who recognized this dilemma. Nineteen century thought about heredity could not as y see beyond a miasma of misconceptions arising fro identification of character differences with gen which determine them within a particular enviro mental framework. This we may amply deduce fro the writings of Galton, than whom few writers ha more powerfully influenced, and more deplorab sidetracked, lucid thinking about the statistics of human populations. As a representative specimen of the Galtonian *Weltanschauung* the following is sufficiently eloquent: "We may, therefore, broadly conclude that the only circumstance, within the range of those by which persons of similar conditions of life are affected, that is capable of producing a marked effect on the character of adults is illness or some accident that causes physical infirmity. The impression that all this leaves on the mind is one of some wonder whether nurture can do anything at all, beyond giving instruction and professional training. There is no escape from the conclusion that nature prevails enormously over nurture when the differences of nurture do not exceed what is commonly to be found among persons of the same rank of society and in the same country."

It would be difficult to extract from deliberate utterances of reputedly competent men of science a combination of *naïveté* and nonsense so transparently belied by results of modern research on human nutrition, or, as R. M. Titmuss shows, more demonstrably belied by relevant data about the trend of mortality during recent years. In 1911 and 1931 the infant death-rates of Class I, the most prosperous section of the community in the Census categories for England and Wales, stood respectively at 76 and 33. Those of Class V—the least prosperous of the Census categories—stood at 153 and 77. From these facts alone several conclusions are compelling. Within so short a period as this no changes of the genetic structure of a population can have contributed significantly to either of two outstanding features of the shift. At both ends of the social scale the chances of death during the first year of life had gone down by about 50 per cent in less than one generation; and the chances of survival of a navvy's baby at the end of the period were as good as the chances of survival of a barrister's baby at the beginning of it.

For the benefit of those who have forgotten what eugenists were saying in 1911, there is no lack of evidence from the record of human superstitions. They are accessible in back numbers of the *Eugenics Review*. The difference between 76 (Class 1) and 153 (Class V) was due to nature, and the efforts of Newsholme and others who sought to alter the *status quo* by changes of nurture were necessarily foredoomed to failure. Oddly enough, this presupposition went hand-in-hand with a hallucination which identified the fittest with survivors from the benefits of the most expensive medical amenities available for safeguarding offspring of prosperous parents against death from 'natural' causes. We now have before us the factual verdict of history. Contrary to what eugenists claimed at that time, events have shown that it is possible to reduce the death-rate of Census Class V to what that of Census Class I was in 1911. So the onus of proving that it is impossible to lower the deaths of Class V to the 1941 level of Class I lies on those who intrepidly and intransigeantly reiterate arguments conclusively disproved by what has happened before. In short, as Titmuss says: ". . . there are no medical, social or economic reasons why advanced communities should not achieve a rate of 15, for the knowledge formerly lacking is now abundantly available."

Besides making accessible in a readable narrative facts too apt to remain buried in census volumes on the shelves of libraries, R. M. Titmuss has undertaken a careful scrutiny of differential infant mortality to meet objections against the admitted imperfections of census classifications. The results of his analysis do not weaken the conclusions tabulated by the Registrar General's Office. They reinforce them. Therewith, the author of "Birth, Poverty and Health" has also extracted from official records another class of facts familiar to too few people and specially relevant to the role of nature and nurture. Among all classes of deaths which occur in the first year of life none is less susceptible to *known* differences of environment than those which occur in the first month. If genetic differences between social classes play an important part in differential mortality among infants, we should therefore expect to find a high dispersion of figures for neonatal deaths. For 1931 (England and Wales) we find that the ratio of neonatal deaths to deaths between 1 month and 1 year in Class I was three times as high as in Class V.

This supplies very strong evidence for the conclusion that the contributory role of environmental differences to observed differences of infant mortality is much greater in the least prosperous than in the most prosperous social groups. The same conclusion emerges from a classification of deaths with respect to diseases at present curable or incurable. The former account for about 86 per cent of total infant mortality. We are, therefore, in a position to state within fairly narrow limits the margin of further reduction which social legislation directed towards the fullest utilization of biological knowledge could achieve. The result fully justifies the anticipation cited above, and forestalls any ground for complacency. As Dr. Newfield remarks in the editorial foreword: "The absolute infantile death-rates among the poorer groups have indeed declined; but relatively to those in the economically better-favoured groups, they are higher, far higher, than ever before."

"Birth, Poverty and Health" is a refreshing indication that there is a rising generation of statisticians and social biologists who have thought their way through the luxuriant overgrowth of misconceptions which Galton's generation planted and Pearson's followers watered. It is temperate and stimulating, lucid and well-documented. It lifts a class of problems calling for immediate legislative action above the fog of political indignation to the level of a factual analysis of human needs and human knowledge available for implementing their satisfaction. As such it deserves a wide circulation among those who cherish what Bacon called the true and rightful goal of science. It is also valuable, because it emphasizes a need long overdue for more exhaustive research into the precise nature of the social agencies contributory to the decline of infant mortality, and the persistence of the differentials the author discusses.

LANCELOT HOGBEN.

EARLY AMERICAN AERONAUTICAL HISTORY

The First Century of Flight in America

An Introductory Survey. By Jeremiah Milbank, Jr. Pp. x+248+24 plates. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1943.) 18s. 6d. net.

JOSEPH CONRAD, in his Nostroms, wrote "The Air of the New World seems favourable to the art of declamation". Judging by Mr. Milbank's book, the air of the New World, and particularly the air of New Jersey, has been very favourable to the art of reclamation of early American aeronautical history.

On December 17 next will occur the fortieth anniversary of that astonishing first controlled flight in a power-driven heavier-than-air craft which was to rank with the discovery of gunpowder, the coming of the printing press, and the wireless as a major event in the history of the world.

Mr. Milbank's history begins with Benjamin Franklin, who was fortunate enough to witness in France the ascent of the Charles balloon on August 27, 1783. In a letter to Jan Ingenhousz, physician to the Empress Maria Theresa, Franklin wrote, prophetically, "It appears, as you observe, to be a discovery of great importance and which may possibly give a new turn to human Affairs. Convincing Sovereigns of the Folly of wars may, perhaps be one Effect of it, since it will be impracticable for the more potent of them to guard his Dominions. It is a pity that any National Jealousy should, as you imagine it may, have prevented the English from prosecuting the Experiment, since they are such ingenious Mechanicians, that in their hands it might have made a more rapid progress towards perfection, and all the Utility it is capable of affording." He stirred up his own countrymen about the new invention with little delay in a letter to the American Philosophical Society.

On January 7, 1785, Pierre Blanchard and Dr. Jefferies crossed the English Channel from Dover in a balloon, and landed in France on almost the exact spot where 273 years earlier Henry VIII and Francis I met on the Field of the Cloth of Gold.

Blanchard was French, Jefferies was American (he was born in Boston and graduated at Harvard College in 1763), and the hazardous crossing which began at 1 o'clock in the afternoon finished at a quarter to four. There followed the usual spate of entertainment which seems to follow any dramatic flight (except, of course, the most important one of all, by the Wright Brothers !). Whether it was due to the two months entertainment or to some other cause, Jefferies gave up his aerial experiments and resumed his career as a medical man in Boston.

The first American ascent was in a captive balloon by a boy of thirteen, as the balloon was not large enough to lift a full-grown man.

Under the patronage of George Washington, Blanchard was the first to make a free ascent in America, on January 9, 1843, his sixteenth ascent. Although the ascent received considerable publicity, the Americans showed great apathy in taking up ballooning. The Frenchmen Guille (1879) and Eugene Robertson (1825) raised a certain amount of interest with their flights. Between 1830 and 1834 Durand with his ascents gave a fillip to the new art, but he was unable, in 1840, to persuade the general in command of the American forces fighting the Indians in Florida to use balloons for "spotting Indian camp fires by night excursions".

The one man in America who did most to direct attention to ballooning was John Wise (1808–79). He designed many of his own balloons, made many hundreds of ascents, carried the first air mail in America, and made every effort to get his countrymen interested in a projected voyage across the Atlantic by balloon. He was the inventor of the ripping panel which removed considerable danger from balloons landing in winds. His book, "Through the Air", gives much data on air currents, atmospheric conditions at various heights and electrical phenomena. Wise had a profound faith in the future of aeronautics and believed that the crossing of the Atlantic by air was not far distant.

Fired by Wise's exploits, another American, T. S. C. Lowe, rose to ballooning fame. To him belongs the credit of demonstrating the use of the military balloon for observation purposes in the Civil War. General Greely wrote: "it may be safely claimed that the Union Army was saved from destruction at the battle of Fair Oaks, May 31 and June 1, 1862, by the frequent and accurate reports of Professor Lowe." (All balloon experts in America were called professors.)

Following the Civil War, a new generation of balloon exhibitionists, acrobats and parachute jumpers took full advantage of the increasing interest of the American public. They served one useful purpose: to make that public air-minded and to arouse the interest of scientific men.

By 1890 more and more attention was being concentrated on the heavier-than-air machine, and the possibilities of the airship. Edison, ten years before, had begun his first investigations into heavier-than-air flight.

In 1883 came the first claim for a glider flight, by J. J. Montgomery, and in 1889 Octave Chanute began his great contributions and was publishing his classic work "Progress in Flying Machines". In 1895 was established the first American Aeronautical Society. Two years earlier, Langley, secretary of the Smithsonian Institution, Chanute, A. F. Zahm and others convened an aeronautical conference at Chicago at which Dr. Zahm read a paper on stability of aeroplanes and flying machines, Hargrave one on flying machine motors and cellular kites, and Langley his famous paper on the internal work of the wind. Here Mr. Milbank's history ends. Ten years after that meeting the heavier-than-air machine was an accomplished fact.

Mr. Milbank has written not only an extremely well-documented book but also one which may indeed be the basis for others. The author gives a complete list of his sources of information, and it is a tribute to his careful research into contemporary records. But as he rightly says in his preface, "This outline history of Aeronautics in the United States before 1900 has only scratched the surface".

It is to be hoped that the author will now begin to dig deeply. J. L. PRITCHARD.

LOWER AQUATIC FUNGI

Aquatic Phycomycetes: exclusive of the Saprolegniaceæ and Pythium

By Frederick K. Sparrow, Jr. (University of Michigan Studies, Scientific Series, Vol. 15.) Pp. xix+785. (Ann Arbor, Mich.: University of Michigan Press; London: Oxford University Press, 1943.) 5 dollars.

THE lower fungi which inhabit fresh and salt water have been for a long time a neglected and mysterious assemblage of organisms, worked fitfully by some investigators, more intensively by others, but standing badly in need of a thorough investigation. Few of them are known to be of economic significance, many are supposed to be rare, most of them are tiny and demand very painstaking observation; to mycologists in general these fungi have been things to be avoided. The lack of any comprehensive account in English, and of a modern survey in any other language, has deterred would-be investigators, who have recoiled from the unwelcome task of searching large numbers of scientific periodicals in a variety of languages, perhaps in the end to find imperfect descriptions difficult to understand.

Much of this is now changed. Dr. F. K. Sparrow, a graduate of Harvard now teaching in the University of Michigan, has provided an admirable guide to the aquatic Phycomycetes, and has abolished, or at any rate greatly diminished, many of the difficulties associated with them. He shows how these fungi can be obtained, often easily; he indicates how they may be observed, and he sets out clear figures and descriptions by means of which they can be recognized.

The generous financial support available to scientific workers in the United States enabled Dr. Sparrow to travel widely. He made two long visits to Great Britain, travelled in Europe, collected freely and observed intensively on both sides of the Atlantic, met mycologists having interests in common with himself, and altogether gathered an abundant harvest of experience, observations, material and impressions. In all ways he equipped himself to write his book, for he added deep and wide reading to his direct work on the fungi. Behind all this there was the tradition set up by the eminent mycologists who have adorned Harvard for the last half-century or so, a tradition of careful observation first, and speculation very much second.

As the title indicates, certain aquatic Phycomycetes are not dealt with in the book; that is because those fungi have been described in detail, and in fairly recent times, by other authors. Dr. Sparrow decided to fix the scope of his book by biological rather than by taxonomic limits. This has entailed a few omissions, and has meant that the descriptions of some of the groups are incomplete taxonomically. Two main series of fungi are described, drawn from what other mycologists have called the Archimycetes and the Oomycetes. The result justifies the scheme, and, now that Dr. Sparrow has shown how useful a biological criterion can be in obtaining a feeling of unity in a book, it is to be hoped that he, or another as well qualified as he is, will earn our gratitude by producing an equally satisfying account of the remaining aquatic fungi.

The book consists of a general introduction followed by a systematic account of the fungi, alliance by alliance. Each alliance is treated uniformly, with a general account of the development, morphology and biology of its members, followed by full taxonomic details of the families, genera and species. The liberal supply of keys makes the book easy to use. About half the space is devoted to the Chytridiales, fungi to which Dr. Sparrow has given much study, and of which he has greatly extended our knowledge. The Chytridiales, together with two smaller alliances, the Blastocladiales and the Monoblepharidales, are grouped together because of their uniflagellate zoospores, in parallel with a biflagellate series made up of the Plasmodiophorales, Saprolegniales, Leptomitales, Lagenidiales and Peronosporales. This convenient and acceptable grouping, though based on a character of the zoospore, is supported by other characters, and seems to bring out well the natural relationships of the fungi concerned. The systematic part is followed by a long list of the substrata inhabited by aquatic Phycomycetes, a very extensive list of references, and a full index. The illustrations are good and clear; it is interesting to note among them a portrait of Zopf, a mycologist whose work seems never to have had the recognition it merits.

The general introduction and the sectional introductions are clear and concise. In them, Dr. Sparrow includes firm, quiet statements of his own opinions, given without dogmatism. That sort of sober treatment characterizes the book and makes of it, in the best sense of the word, a solid contribution to the progress of botany. "Aquatic Phycomycetes" takes its place as the standard book on its subject; it is likely to be a long time before another author arises, able and qualified to write a better.

While the book will appeal chiefly to mycologists, it will be of the utmost value to all students of aquatic life, and will stimulate renewed investigation of the aquatic fungi. It should be in every botanical laboratory, and would not be out of place in zoological surroundings, for numbers of aquatic Phycomycetes have associations with animals, and we do not yet know how significant these are. It may be, for example, that Catenaria can be used to secure the biological control of the liver fluke.

A word of congratulation is due to the University of Michigan, for it is that body which has made possible the publication of the book. In these times, especially, it is refreshing to find that there is still money and sentiment in the world, available to support the production of books on specialized subjects remote from ordinary experience and of no obvious economic application.

B. Barnes.

HISTORY OF X-RAY ANALYSIS

The History of X-Ray Analysis

By Sir Lawrence Bragg. (Science in Britain Series; Published for the British Council.) Pp. iv+24+4 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1943.) 1*s*. net.

The British Council has done well to add this pamphlet to its "Science in Britain" series. Nobody else now alive could have written it with quite the same zest as Sir Lawrence Bragg: he has produced an essay in close accord with his title, the "History of X-Ray Analysis"; and that is what is wanted.

There are certain things worth saying even if, in other contexts, they have been said or implied before. One is the footnote on p. 3, which explains once and for all, to the layman, the difference between X-ray analysis and radiography. It is surprising how deep-rooted is the confusion about this in the popular mind. Another is the description of early days spent battling with a crystal structure, even "living with it", and dreaming of it for a year. To recapture such a mental atmosphere is exhilarating, and the gentle rebuke to the younger generation may not go wholly unheeded. Anyway, we shall do well to recollect it when looking up crystal structures, as we do now, with little more concern than finding telephone numbers. For the rest, there is much of interest, though maybe along somewhat more traditional lines.

The concluding paragraph raises a hope, now probably forlorn. It is that this little book might reach Prof. von Laue, to lift a trifle his distress of mind, and to assure him that a certain haunt of students and their teachers in Munich, as it was in 1912, is still an honoured memory.

F. Ian G. Rawlins.

POTATO EYES AS READILY TRANSPORTABLE 'SEED' FOR THE COLONIES

By SIR GEOFFREY EVANS, C.I.E.
Royal Botanic Gardens, Kew

IT has been known for some time that the propagation of potatoes from small pieces of sets and even from single eyes or sprouts is quite feasible. Such methods have indeed been employed by nurserymen and others when the rapid increase of some specially good or new variety was necessary. It is only recently, however, that the practicability of introducing some such system into commercial methods of cultivation has really received careful attention.

It is obvious, of course, that if satisfactory crops can be raised by using only a small portion of the tuber as 'seed' there will be a great saving, as the remaining portion will be available for food or processing purposes, since this would represent a saving of between 80 and 90 per cent of the total crop. This is a matter of particular importance in war-time, when every pound of food is wanted and all waste must be eliminated. It is especially so in the U.S.S.R. where so large an area of food-producing land is in enemy hands.

Recent information[1] seems to indicate that practical means have been devised by Prof. Lysenko and his co-workers of the Lenin All-Union Agricultural Academy and that most of the potato tuber is now used for food, small portions of the skin, including the eyes, being reserved for seed purposes. Similar unorthodox emergency methods have been discussed by Copisarow[2]. Likewise, Polunin[3] has shown the possibility of small-scale cultivation of potatoes from detached sprouts.

But apart from the actual saving of food involved by these methods is the great saving of transport. In Great Britain alone, several hundred thousand tons of seed potatoes are moved from Scotland or Northern Ireland each spring to meet the demands of potato growers in England, and if 70 or 80 per cent of the bulk and weight involved could be eliminated it would mean a considerable relief to railways and the transport system, and would probably do away with the awkward delays in delivery that are bound to occur under existing conditions.

The particular problem that was placed before me, however, was the supply of potato seed to certain British overseas dependencies. Among those countries where the potato has now been established as a farm crop may be cited Cyprus, Malta, Palestine in particular, and also Kenya and parts of Nigeria. In these countries the potato has come to stay and is consumed not only by Europeans but also to an increasing extent by the natives themselves. In most of these places, however, experience seems to indicate that fresh seed needs to be imported either each year (especially in places where it is found impracticable to keep seed from one planting season to the next) or at regular intervals in order to re-introduce fresh and vigorous stocks.

War-time transport conditions have rendered these seasonal importations most difficult to maintain. Either transport is not available at the right time, since all shipboard space is required for military stores, or the voyage is so delayed by the hazards of war that the 'seed' arrives in a spoilt condition and often too late for the planting season.

It was decided, therefore, to explore the possibility of sending planting material by air, and it soon became evident that the sending' of seed potatoes of the usual trade size by this means would not only be too costly but would also be impracticable owing to the weight and bulk of the seed. There seemed to be two ways of meeting this difficulty. One was to dispatch the 'seed' in the form of very smal chats the size of marbles, and the other was to send the 'eyes'. The latter seemed to offer the greatest possibilities for air transport as the weight involved would be least.

The problem consists of devising some simple means by which the smallest possible portions or 'chips' of the tuber could be dispatched with safety by air with a reasonable assurance that when planted they would be capable of producing a crop at least comparable with that grown from normal seed. Allowing for reasonable delays in packing, dispatch and distribution, it was considered that such 'chips' would have to retain viability for about a month or so and would have to withstand a certain amount of rough handling.

A study of recent Russian literature seems to indicate that methods of this sort have been adopted on a very large scale in that country, but unfortunately no details are available of the actual method used or the means employed to 'cure' the cut end of the seed and to preserve viability until the planting season arrives. It seems obvious that unless the cut end can be sealed rapidly the entry of fungi or bacteria mus speedily result in the death of the eyes. Experiments to this end have been conducted in the United State by the Franklyn Research Co. and other workers[4].

Arrangements were made to lay down some observation plots this year at Kew with the object o seeing how the relative yields of potato crops raised from eyes, chats and normal-sized seed compared. Spring had already arrived, but the necessity for no missing the growing season was realized, and therefore potato tubers were used which already showed signs of sprouting.

The method employed for preparing the eyes wa deliberately designed to be as simple as possible, s that the procedure, if successful, could be adopted by any practical person with the minimum of labour and would need no special skill or manipulation Most of the eyes on a potato are found at the 'rose end, and so the tuber is held in the left hand and thin slice or 'chip' cut off the 'rose' end with a shar knife. These 'chips' varied somewhat in size wit the shape of the tuber, but on the average they were about 1 in. in diameter, some being round others more oval in shape. The thickness of flesh was about a ¼ in. at the thickest part. When sufficient 'chips' had been accumulated they were collecte and placed, cut surface upward, on shallow trays, the bottoms of which were covered with a thin layer o peat-moss litter. The main object of the peat-moss was to prevent injury to the sprouts. The trays wer placed on shelves in a wooden seed-store room a ordinary air temperature.

It was found that after about twenty-four hours the cut surfaces had hardened and that in three o four days they had assumed a concave shape owing to shrinkage through loss of moisture. In the field experiment those 'chips' which were cut on the morning of March 24 were planted on the afternoon of March 25 and a perfect stand was obtained.

With the view of getting some idea of the length of time viability remained good, a further lot of twenty four of these 'chips' which had been stored (after twenty-four hours over the peat-moss layer) in ordinary wooden seed boxes were planted on April 3, that is, ten days after cutting. During that time they had shrivelled to about half their original size and looked like slips of cardboard. All the twenty-four 'chips' planted sprouted and grew normally. A fortnight later another small lot was planted and about 80 per cent sprouted. No special treatment was given to the soil, which was in good average condition for planting so far as soil moisture and tilth were concerned.

The variety used was the main crop 'Majestic', a well-known commercial potato. The only material available was certified Scottish seed obtained through Messrs. Carters of Raynes Park, who were also instrumental in providing the chats required from the same source.

The weights of seed used worked out as follows :

Normal war-time seed	15 cwt. per acre.
Chats for seed	6½ cwt. per acre.
Chips (eyes) *before drying*	3 cwt. per acre.

War-time seed, it should be noted, weighs heavier than normal peace-time seed (which averages about 13 cwt. per acre) as it contains a bigger proportion of out-size tubers. The 'chips' when dried weigh ess than half as much as the fresh material. In a small trial to find out the loss of weight, twenty-four rose ends or 'chips' weighed 8 oz. at the time of cutting. In twenty-four hours their weight was 7 oz., and at the end of another six days they weighed 3½ oz. In other words, the loss of weight after twenty-four hours was about 12 per cent and after a week about 65 per cent.

As the weight of fresh rose ends used for planting is about 3 cwt. per acre, the weight required after drying for a week will be about 1 cwt. In other words, one fifteenth of the weight of normal seed would be required. This is a matter of great importance in connexion with the export of potato seed for overseas countries when transport has to be considered. So far as yields are concerned, owing to limitations of land and labour it was only possible to carry out plain observation plots which consisted of three rows 96 ft. long of each kind of seed. The rows were 2½ ft. apart, but whereas the whole tubers were planted 1½ ft. apart, the chats and the 'chips' were planted 1 ft. apart. There was also a difference in depth of planting depending on the size of the planting material used ; the larger the size the greater the depth. Thus the whole tubers were planted at a normal depth of 6–7 in., the chats 3–4 in., and the chips 2–3 in. The young plants were earthed up as hey grew in the ordinary way, and on account of danger from spring frosts it was found necessary to earth the 'chips' rather sooner than the other two as the shoots appeared above ground somewhat earlier, but sprouting was very even in all the rows. The early part of the growing season was dry and cold and growth was slow. This was especially true of the 'chips', which were retarded by the necessity for early earthing up as a protection from frost, but as the season advanced these rows rapidly progressed and by the middle of July they had covered in as well as, if not better than, the other two. The plots were harvested on September 29.

The size of the plots consisted of three rows of 96 ft. × 7½ ft. or just about 1/60 of an acre each. The yields are given in the accompanying table in lb. per plot.

The crop after harvesting was put through two riddles of 1 in. and 1½ in. to separate out the tubers into three sizes.

In general the results from these small preliminary trials are promising in so far as they indicate the possibility of raising satisfactory crops of tubers from the rose ends dried into 'chips', by a simple and easily manipulated method. The results indicate that, while the yield from the 'chips' is not quite so good as it is from normal seed, yet the crop is satisfactory and better than that from chats. But it is obvious that much more needs to be done and that detailed experiment is needed to follow up this year's trials. In the first place it will be necessary to standardize the method of preparing the 'chips' for export. We still have to ascertain how long the viability of the chips can be maintained. There is also the question of dormancy in the potato. In the trials described above, seed was used which had already begun to sprout. It remains to be seen whether equally good results will be obtained from unsprouted seed. Details of planting also need further investigation. In thi, year's trials the 'chips' were planted one foot aparts but there is reason to believe from the experience gained that a somewhat wider spacing might give equally good results. Experiments are also needed in the depth of planting, and it is necessary to determine the varieties most suitable.

The chief application of this system would probably be with the Mediterranean territories, that is, Cyprus, Palestine and Malta in the first instance, although there are also possibilities in Colonies farther afield such as Nigeria and Kenya. In the Mediterranean countries the planting seasons vary. Thus in Cyprus the main crop, it is stated, is planted from August to mid-September. In Palestine the autumn planting is from mid-August to mid-September, the main planting in November and the spring planting from January to March. In Malta the spring planting is December to February, the summer planting March, and the autumn August–September.

If the seed is to be provided from Great Britain

Method	Total yield	Grading and approximate % of total yield					
		Ware		Seed		Chats	
		Weight	%	Weight	%	Weight	%
EYES— (3 rows, each 96 ft. long, 2 ft. 6 in. apart, 12 in. between sets)	526 lb.	475 lb.	90·3	33½ lb.	6·4	17·5 lb.	5·3
CHATS— (3 rows, each 96 ft. long, 2 ft. 6 in. apart, 12 in. between sets)	474½ lb.	411½ lb.	86·75	31 lb.	6·5	32 lb.	6·75
NORMAL SEED— (3 rows, each 96 ft. long, 2 ft. 6 in. apart, 18 in. between sets)	613½ lb.	558 lb.	90·96	29¾ lb.	4·84	25¾ lb.	4·20

for the August–September planting and if the tubers have to show signs of sprouting before preparing the 'chips', it is possible that an early variety of potato might be most suitable. For the later plantings, mid-season or main crop types would probably succeed. These and other details afford a fruitful field for future investigation.

Meanwhile it is hoped that it will be possible to send out small trial consignments of 'chips' to these Colonies by air or fast ship transport during the present autumn. The chief advantage of the system seems to be in the great saving in transport space and weight, and it would seem therefore to be specially applicable to the large and increasing trade in certified seed potatoes with the overseas markets.

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[1] Information supplied by the Ministry of Information from collected reports from Russian sources.

[2] Copisarow, Maurice, NATURE, 151 (1943).

[3] Polunin, *Gard. Chron.* (January 23, 1943).

[4] *Amer. Potato J.*, 14, 23 (1937).

SOME ASPECTS OF SOCIAL BIOLOGY*

By SIR WALTER LANGDON-BROWN

IT requires all one's power of sympathetic imagination to penetrate the intellectual and spiritual twilight amid which Henry VI lighted twin lamps of learning at Eton and King's College, Cambridge, following the example of William of Wykeham at Winchester and Oxford. The bright dawn of the passionate desire for learning that lighted the end of the twelfth century had faded away, the land had been devastated by the Black Death and the nation was being exhausted both materially and physically by the Hundred Years War. For nearly a century no new college had been founded at Cambridge, and Oxford was in a decline. The efforts of this saintly weakling, Henry VI, have thus proved more enduring than his father's victories and more significant than all the internecine struggles of Yorkists and Lancastrians. It is his imperishable glory to have proved the superiority of things of the mind and spirit over the clamour of battle. Well did Wordsworth say of him

"Tax not the Royal Saint with vain expense".

There is another aspect of his times which is germane to the subject of social biology. The human mind is too apt to prefer revolution to evolution. So much so that well into the nineteenth century men believed the world to have been constructed by a series of geological catastrophes. It required the labours of many geologists to prove that the principal agencies were the same as those peacefully at work to-day. Slow erosion and steady deposition of stratum after stratum have wrought more than all the volcanoes and earthquakes. Yet man still tragically retains his belief in methods of violence. But when we come to closer examination we find that, as Thomas Mann pointed out soon after the War of 1914–18, revolutions often really conceal reaction. His essay does not appear to have excited much interest at the time, but it was so prophetic in tone and so penetrating a study of German mentality that it gains fresh interest at the present juncture.

He starts by adopting Nietzsche's view that the latter part of the nineteenth century was characterize by two leading motifs—reaction masquerading a progress, and subservience of reason to emotion Though not confined to Germany they were speciall potent there. He elaborates this by maintainin under the first heading that reformations by thei very nature may have little to do with progress since they tend to re-establish the old in an extremel conservative sense, and that at a time when the new is already known, while the second arouses sympath with the chthonic and dæmonic, with night an death—in short, with a primeval and earth-bor religion. This recognition of the feeble contro exerted by the reason and intellect, and of thei incapacity to condition life, has led to scorn bein poured on reason as an unfruitful illusion, and t the reinstatement of the irrational and instinctive When reaction disguises itself as revolution, it succeed best with youth, which not being fortified by experience against such tricks, can be beguiled into accepting the most outworn devices as promising novelties The revolutionary freshness of youth has impresse upon it the "principle of mindless nature, the foll soul, hatred, war . . . the great retreat dressed ou in the uniform of the advance guard . . . Is yout really going to fall victim to this crude abuse of th new knowledge ? . . . We are no longer strangers t the disheartening sight of youthful bodies in ga quickstep, songs arising from young life, arms flun in a Roman salute, wasting the fine flight of thei youth upon hoary ideas." Since he wrote thos words, history has answered his questions. As Ker Clarkson expressed it in his "Europe in Eclipse" Hitler's "Youth Movement was his method of harnessing the challenging demands of puberty to th service of the State", while Howard Smith in hi vivid "Last Train from Berlin" concluded from stud on the spot that the Nazi "Ship of State has ridde the waves, not of the future, but of the blackes past". Hitler has completed what Wagner began—the exploitation of the myth.

The recent arrest of the veteran physiologist, Pro Lapicque, in Paris and the suppression of the *Press Medicale* are typical of much. Science, literatur and art are to be tolerated only in so far as the are within the comprehension of the autocrat. An higher values are met with the retort of Goethe Mephistopheles : "I am the spirit that denies".

Indeed, we must admit that a reactionary elemen is not uncommon in revolutions. The lictors' rod are suitable symbols for Fascism, for the Roman have been the most persistent *laudatores temporis act* in all history, even in the moments of their greates conquests. The renaissance of Irish nationalis gained force from the Celtic twilight, represente poetically by W. B. Yeats and pictorially by hi brother.

One of the most striking forms which this reactio has taken is a denial of the advantages of liberty—and that underlies much of the planning so fashionab even in Great Britain, while the other is the conceptio of the State as the supreme force. In my youth th State in England was on the whole benevolent t the individual, though like a rather inquisitive Aunt about our pocket money. It was not until I bega to travel abroad that I realized that on the Continen the State was in the main hostile to the individua Totalitarianism is no new idea, and when it is adopte the deification of the State, the divine right of king revived in a still more absolute form, is not far o Indeed, Hegel proclaimed the State as the "divine ide as it existed on earth". But when the State becomes God, it soon declares itself as indeed a Moloch, passing its own children and those of others through the fire. As social biologists we are naturally concerned to discover how things have come to such a pass, and it is somewhat disquieting to find that science has unfortunately played its part, not merely by placing powerful weapons of destruction in hands unfitted to use them, but more subtly by promulgating as facts, views of heredity which are merely theories. In the hands of pseudo-scientists this has wrought much damage.

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* Substance of the opening address to the British Social Hygiene Council's Summer School held at Eton College during August.

Instances which will occur to anyone are the perverted use made of Darwin's phrase "natural selection" and Herbert Spencer's "Survival of the Fittest". No one stopped to inquire "fittest for what ?" and I regret that Sir Arthur Keith permitted himself to utter the palpable error that the "pruning hook of war" exemplified natural selection. At any rate, neither Darwin nor Herbert Spencer ever ruled out the idea of progress. That was left to Weismann, the Calvinist of biology as I have often called him, with his rigid delimitation between the soma and germ plasma. This denied the possibility of the inheritance of acquired characters, which Darwin to the end of his days was never dogmatic about. Hope stirred once more when mutations were discovered, only to be dashed again when it was found that the great majority of mutations were unfavourable to survival.

Meanwhile the study of variation, for which Darwin had never been able to account, underwent complete re-orientation when the Abbé Mendel's forty-year old work was rescued from oblivion. Genetics became an exact science, and it was found that man was a very variable animal. Only 9 per cent of us are obliging enough to have our greater splanchnic nerve as figured in the anatomical text-books, and it has been laid down that nothing should be labelled as an abnormality unless it occurs in less than 4·5 per cent of individuals. A 'normal' man is merely an intellectual concept; we are of an infinite variety. Moreover, to these structural variations the chemical embryologist has added many functional ones.

The time is ripe, therefore, for a full inquiry as to the inheritance of acquired characters. To do so is, of course, rank heresy, which is usually rewarded with excommunication by accredited men of science. I am therefore rejoiced to find that Prof. Wood-Jones in his little book "Habit and Heritage" has courageously dared this: first, because biologists of the past have been too exclusively interested in structure to the neglect of the moulding force of function, and secondly, because the social applications of biology have foundered on this rock more than any other. As Prof. Wood-Jones says "it is a patent fact that there has been a lowering of standards and a shrinkage of human spiritual ideals". The grafting of ridiculous claims for the application of the term 'fittest' to a certain section of the community on to the Darwinian survival thesis has gone far towards producing the sinister theories which have let loose the present demons of bloodshed and destruction. These terms, employed in the first place as purely scientific expressions, have become converted into the slogans of propaganda for acts of unthinkable brutality on a vast scale. Loud voices acclaim that it matters not if we live good lives or bad for, apart from direct disease or social degradation, we cannot hand on to our descendants any virtue or vice, any talents or degeneracies that we may have acquired during our lifetime. Consequently there was no prospect that we shall ever be able to bring about a permanent elevation of the human race by means of education and practice.

Science has broadcast the doctrine of the survival of the fittest; pseudo-science has grafted on to this pronouncement the implication that the fittest are those most red in tooth and claw. Science has broadcast the doctrine of the non-inheritance of acquired characters; pseudo-science would translate this doctrine into a thesis of racialism more cruel, more destructive of hopes of human betterment and of the attainment of international amenities than any of the other bastard slogans of our times. Therefore man inquires into the basis of the theory of such non-inheritance and finds it lacking. On the other hand, he brings forward evidence that germ cells do not possess that developmental, anatomical and physiological isolation from body cells demanded by Weismann's theory. The recent advances in chemical embryology support this proposition. The earlier stages of development are extraordinarily plastic prior to the appearance of any germ cells. This strikes at the root of Weismann's theories. But the inheritance of acquired characters in any event could only be in a very gradual process, and cannot yet be regarded as proved.

It would not be just to ascribe all the disastrous deterioration in moral values to mishandling of the biological theories. Certain philosophers and especially Hegel must take their share of the blame. When we inquire into the validity of the claim for "the biological necessity of war", it is interesting to learn what light the newer psychology has to throw on the subject. We shall at once be told that aggressiveness is deeply inherent in human nature, but it is repressed by society until it becomes so intense that it can find an outlet only in warfare. But when we ask what is the origin of this aggressiveness we are given two diametrically opposite answers.

Thus Freud attributed it to the persistence of childish hatred against parents, brothers and sisters which he regarded as our most fundamental impulse. He maintained that social feelings arise as a superstructure founded on these jealousies and rivalries, and thus the hatred we repress with difficulty remains the mainspring of our corporate life. His own feelings are displayed in his statement that "the masses are both lazy and stupid, and their ingrained laziness will not be removed by kindness but only by leadership prepared to use appalling force . . . One cannot deny the grandeur of this project". Well, his nation have experienced this since those words were written, but "the grandeur of the project" is perhaps beginning to lose its appeal.

On the other hand, Ian Suttie, who was trained in the Freudian School and used its methods for years, concluded that aggressiveness originated from the thwarting of primary natural love. Dr. Ranyard West in his interesting study of "Conscience and Society" says that Suttie puts forward the biological and individual role of the nourishing and protective mother and the sociological reactions which may result from her place in life as opposed to those of Freud's threatening father. Thus for Suttie the germ of society is a band of brothers and sisters gathered under a mother, as opposed to Freud's brothers banded in hostility against a father. I might interpolate here that it is, of course, quite possible for a matriarch to imitate Freud's conception of a father. I recently read Harold Nicholson's "Life of Hamilton

Rowan", whose dominating mother was the mainspring of his rebelliousness throughout his life, despite his frequently expressed desire to please. West goes on to say that the reactions of Suttie's patients were different from those of Freud because the personalities, the mental adherences and the faiths of the two analysts diverged.

Now if two astronomers working with similar telescopes at Greenwich and in Cape Town gave different times for the rising and setting of the moon they can both be right, the difference being due to their different positions on the globe. But psychologists are not observing through telescopes; they are observing human beings through their own minds which are deeply coloured by their own experiences. In the same way, a portrait, unlike a photograph, tells us much about the man who painted it.

Now this divergence between philosophers is no new thing. Nor is totalitarianism a new idea. It was first proclaimed by Thomas Hobbes in the seventeenth century. Although he was born in the year of the Armada and lived nearly up to the time of our Revolution in 1688, thus seeing great changes, he never altered his view that men were all selfish and aggressive, each against his fellows in a life that was "nasty, brutish and short". "So in the nature of man," said he, "we find three principal causes of quarrel—competition, diffidence and glory. The first maketh a man to invade for gain, the second for safety and the third for reputation". Thus war was the natural state of mankind and "force and fraud are in war the two cardinal virtues . . . Covenants without swords are but words and of no strength to secure a man at all." In that last respect he would find more to agree with him now than in the nineteenth century!

Yet the physician-philosopher, John Locke, who lived through the most disturbed part of the same century (as he said "I no sooner found myself in this world than I found myself in a storm") differed from Hobbes in precisely the same way that Suttie differed from Freud. He believed that a demand for social love and approval from his fellows was the primary emotion in man. He averred that he who "declares himself to live by another rule than that of reason and common equity [committed] a trespass against the whole species". Ranyard West's comment is "in contrast with Hobbes, Locke's state of nature is in fact a state of good nature . . . Where Hobbes sees anarchy unless men give up self-government, Locke sees a natural community which will improve its condition by careful self-government and run no risk in the process". To-day it is of special interest to read of this controversy of nearly three centuries ago between two opinions which hold the field to-day.

Now it is significant that Hobbes had a violent father and Locke had not. Hobbes' mother had such a dread of the Spanish Armada that he was born prematurely. As he put it long afterwards, "She brought forth twins—myself and fear". A brutal father and a terrified mother bred in the son a gloomy totalitarian philosophy which had an unfortunately wide influence.

Indeed, in view of the tremendous influence of our early upbringing, it is not surprising how frequently philosophers and psychologists who regard hate as the strongest motive had unkind or even brutal fathers, while those who put love in the first place had affectionate mothers.

What is true of these learned men is of general application. It adds new force to the recognized vital importance of the home; it adds tremendously to the responsibility of parenthood. It is well known what a large proportion of neurotics and criminals come from 'broken homes'. There are plenty of instances of totalitarian leaders having an unhappy childhood.

The fatal flaw in Hobbes' premises was that he regarded human beings as isolated individuals *in vacuo*, whereas inescapably the earliest social group is the family, and the reaction of the individual to that group determines much of his future outlook on the whole of his subsequent life. As a medical man I am profoundly impressed with the truth of this. Let me take what may seem a trivial illustration: the myth of Santa Claus. Here is a boy who determines to find out about it and soon discovers who plays the part of that Christmas visitor. He is not capable of realizing that this is merely the mythical expression of an encompassing parental love, and later on may reject the symbolism of the Book of Genesis—at least until he is over forty. His sister may suspect the identity of Santa Claus, but may close her eyes to it, clinging longingly to the idea of the nocturna visitant with his reindeer sledge. Later on she wil be equally ready to close her eyes to anything which she fears might shake her rather timorous faith.

I have on a previous occasion urged the importance of a boy's reaction to his first realization that his hitherto thoughtless cruelty is wrong. I am sure from the histories I have often obtained that this is an almost universal and dramatic experience. It has been beautifully related by Frank Kendon in his delightful book "The Small Years". If cruelty is persisted in after that, what has been almost natura behaviour assumes a new significance, and the seeds o sadism are sown. "For without the law sin was dead . . . but when the commandments came, sin revived".

Of the tragic results of both bad heredity and bad early environment in exalted circles, one could scarcely find a more striking example than the founder of Eton College. Henry VI succeeded hi father when only nine months old. Henry V was no mere swashbuckler; he had a strong sense o justice and was fond of music and literature. So fa so good, but his mother's stock was bad. With such heredity and an unfavourable environment it is no surprising that he had a complete mental and physica breakdown when he was thirty-two. The loving meticulous care he devoted to his two foundations which he initiated when only eighteen, gave promis of a happier career had he not been doomed from th cradle by a thoroughly evil family environment.

It has been well said that heredity determine what we can do and environment what we do do. The trouble with eugenists is that they are not alway clear what their aim is—whether for brain or brawn. Certain it is that a biological inferiority may b consistent with genius. Turner's defective eyesigh was utilized by him to create gorgeous visions, many immortal works have been produced by the tuberculous, and Beethoven's hereditary otosclerosis did not prevent his reaching supreme heights in musica composition.

Carr-Saunders has recently reminded us that w find it more attractive to think of mastering ou surroundings than of mastering ourselves. Th pioneer efforts of Galton in the latter direction were weakened by his conventional class consciousness and lack of appreciation of social problems; still true was this of some of his disciples. Consequently professional biologists stood rather aloof, and indeed until the re-discovery of Mendel's work lay bare the mechanism of inheritance, eugenics could scarcely claim to be a science. The obstacles in the way of making a genetic analysis of man are immense, but apparently the results obtained so far do not clash seriously with Galton's intuitive conclusions. We must remember that inheritance merely means that offspring get their genes from their parents, while environment includes for man not only physical factors, as for all animals, but also the provision of opportunities for learning.

The object of social organization is not standardization, but the creation of conditions under which genetically unique individuals (which we all are) can best fulfil the promise that is in them. Unfortunately there is reason to suspect that the genetic material in a civilized society deteriorates slowly, but almost certainly, for harmful mutations are preserved which would perish under cruder conditions. True, they are compensated for, but that is not cure, and their persistence must be injurious to the common stock. There are always some people of subnormal mentality and physique who cannot hold their own in the circle in which they were brought up and who therefore tend to sink. The damage is enhanced by the inverse relation which exists between social class and fertility, even though this is now on the wane, except in the lowest group of all. In the other strata the average of intelligence does not vary greatly. But the danger of unfavourable mutations occurring and being encouraged to persist Carr-Saunders regards as insidious, for there is a not inconsiderable element in the population which by reason of inferior hereditary endowment cannot take advantage of a good environment.

Biology can be a useful corrective to the machine-minded planners who are running riot to-day, for man is not a robot. We start with the initial advantage that children are all intensely interested in the manifestations and origins of life—sometimes to the confusion of their more conventionally minded elders. Though of recent years motor-cars, aeroplanes and radio have claimed an increasing amount of their attention, there are few who do not, if they can, keep some kind of domestic pet, occasionally of a somewhat exotic type. It would be a real disaster if education were so directed as to suppress this interest in living things instead of using it as the basis for learning something about man's place in the universe among other forms of life.

On one hand it seems illogical to separate scientific questions from their application to human affairs, while on the other hand it is absolutely essential that there should be complete freedom in scientific research. Yet at the moment there is a decided movement to place research under State control. Liberty seems to be a demoded ideal. We may legitimately inquire how it can be determined at the outset of a research what its practical benefits will be. What we do know is that most of the great scientific discoveries have been made by men actuated simply by a thirst for knowledge. As Prof. Starling said, all knowledge faithfully pursued for its own sake ultimately yields useful results. Thus one of my teachers, W. H. Gaskell, researched on the rhythm of the heart and on the sympathetic nervous system without any thought or even interest in possible clinical applications. It was not until several years later that this work became the basis of newer conceptions of heart disease and of the effect of the emotions on the state of the viscera.

Biology can bring valuable information and advice to the statesman, if the evidence is objectively criticized by those scientifically trained, but if controlled by politicians it rapidly deteriorates into a fallacious guide; a blind leader of the blind. Indeed, we know that with the best will in the world it is extraordinarily difficult to remain sufficiently objective if we start a research for the purpose of establishing a preconceived hypothesis. I gave up laboratory research myself partly because I felt that difficulty was too great for me. The goal of clinical research, on the other hand, is pre-ordained—the healing of the patient. Politics, being in its essence tendentious, cannot control objective science without disaster. The converse aid which biology can render to statesmanship is admirably indicated in Dr. K. E. Barlow's admirable little book "The Discipline of Peace". He bases his appeal on the broadest biological grounds. He insists on the inexorable interdependence of soil, vegetation and animal life, pointing out in no uncertain tones the failure of the industrial age to observe it and the grave consequences thereof. In an interesting way we are led from a consideration of the building up of fertile soil by vegetable life to the building up of potential energy through photosynthesis by plants, which provides for the kinetic activities of animals, combined with the reverse process by which animal and vegetable waste products are utilized. The facts are well known, though not, as he shows, always acted upon. But the point he emphasizes is that each of these entities is obliged to follow its own discipline, and that interference by man can and does disastrously upset the balance. Deforestation, often merely to supply newsprint, and agriculture pursued to yield immediate returns regardless of the future, are rapidly reducing large areas of previously fertile land to dustbowls or swamps. Industrialization has led to excessive raids upon Nature to supply the machine, and the products of those machines have in turn to be bartered for yet more products of the soil. Moreover, it has led to aggregation of population into towns, thus simultaneously increasing the demands on Nature while diminishing its yield. Man must cease to be a bandit of the soil and in turn observe his own discipline, which he can do only by the free exercise of his intelligence. If we want to build a world in which men can live at peace, we have no choice but to pass to a new era in which man must concern himself with the balance and harmony of life. The whole thesis is convincingly worked out to show that while physics may increase our material comforts (or we might add, pave the way to new disasters), only biology can be the scientific guide to a true way of life.

In conclusion, may I suggest that all of us as teachers can gain inspiration and refreshment from Sir Charles Sherrington's short book on "Life's Unfolding", traced from the synthesis of the protein molecule, through the microscopic cell, on to an "organized life-system centred upon itself". Here it is interpreted by a master of science who also has the mind of a philosopher and a poet. He reminds us that wonder commonly vanishes with childhood. The wonderful is taken for granted, so as to enable us to get on with life. Much later, when life's pace is slackened, wonder may return. Wonder, then, is the mood in which he invites us to approach his subject; and it is indeed a wonderful re-telling of the story, vivid and yet accurate in its details. One is reminded of a picture which, having become dulled in colour, is restored to its pristine freshness by a skilful hand. Take, for example, the description of the great adventure by which marine animals adapted themselves to a terrestrial existence and yet still carry the salt of the archaic sea in their internal economy. Avoiding anthropomorphism in his discussion of 'higher and lower' forms of life, he still claims that range of dominance of the environment is a feature to which the term 'higher' can be accorded. Since mind is one of the great keys to this dominance, the term is almost graded by degrees of mind. At the present time, man is, as regards conquest of his surroundings, the most successful of all living forms. On that ground we can acclaim him the highest of all living forms.

It is towards greater control over that environment, which also involves greater control over ourselves, that the lessons of biology and all its application should lead. For in the wise words of Plato, "Civilisation is the victory of persuasion over force".

HENRY TRIMEN, F.R.S. (1843-96)

By T. E. T. BOND
Tea Research Institute of Ceylon

HENRY TRIMEN was born in Paddington, London, on October 26, 1843. He received his education at King's College School (then in the Strand) and even as a schoolboy showed an ardent liking for natural history, beginning to form a herbarium and frequently visiting the Botanical Department of the British Museum to determine his collections. As with so many others of those days, he found his best opportunity of receiving further biological training lay in the study of medicine, and from school he entered the Medical College at King's in 1860, graduating M.B. with honours in 1865. After graduation he held for a short time an appointment as medical officer during a cholera epidemic in the Strand. But already it was clear that his main interest lay in the field of systematic botany. For this subject he was exceptionally well endowed with a natural ability for thorough and accurate observation and with a strong interest in historical studies, while his work throughout was characterized by a breadth of outlook to which his medical background made no small contribution.

As an amateur botanist, Trimen had already made a name for himself by adding to the British flora our smallest known flowering plant—the duckweed *Wolffia arrhiza*—and he had also taken an active part in the proceedings of such bodies as the Society of Amateur Botanists (now defunct) and the Botanical Exchange Club. Official recognition soon followed in his appointment, in 1867, as lecturer in botany at St. Mary's Hospital Medical School and, two years later, as assistant in the Department of Botany at the British Museum. His position now gave full scope to his abilities and he applied himself actively to his chosen fields of interest. In systematic and topographical botany, his best-known early work was the "Flora of Middlesex", projected as a joint publication with his former school-fellow Dyer (afterwards Sir W. T. Thiselton-Dyer) and completed in 1869. Several other papers followed, including critical studies of British species of Polygonum, Rumex, etc. His work in the interests of the botanical community in general was of no less importance and included the arduous task of editing the *Journal of Botany* for nearly ten years. He took an active part also on the council of the Linnean Society of London, of which he had been a fellow since 1869. Finally, mention must be made of the notable series on "Medicinal Plants", undertaken in collaboration with Prof. Bentley, and published in instalments from 1875 onwards. Trimen's contributions to British botany were brought to a close in 1879, on his departure for Ceylon to become director of the Royal Botanic Gardens, Peradeniya.

In Ceylon, Trimen will always be remembered as the author of the monumental "Handbook to the Flora of Ceylon". This work, dealing with nearly 2,800 species of flowering plants in more than a thousand genera, was planned on a generous scale following the arrangement of the "Flora of British India". It was the result of much preliminary research into the Island's flora and the history of its investigation, from the work of Hermann in the seventeenth century and the publication of Linnæus's "Flora Zeylanica" in 1747, to the appearance of Thwaites' "Enumeratio" in 1864. The first volume of the "Handbook" appeared in 1893 and the author himself completed two more volumes in his life-time, covering the dicotyledons from the families Ranunculaceæ to Balanophoraceæ, inclusive. The remaining families of dicotyledons, with the monocotyledons and cycads, were covered in two more volumes by Sir J. D. Hooker, working in part from Trimen's notes. The Flora, thus completed in five volumes by 1900, was revised and extended in A. H. G. Alston's supplementary volume issued in the same format in 1931.

Trimen's work for Ceylon botany in its widest aspects was not confined to the systematic examination of the country's flora: his labours are also commemorated to no small extent in the comprehensive collections and spacious arrangement of the world-famous Gardens of which he was the director. In his official capacity he also took a prominent part in developing the Island's important tea and rubber planting industries, and in introducing many of its fruits and other exotic agricultural products. He retained all his old interest and pleasure in the society of other botanists, and from time to time welcomed to Peradeniya such eminent visitors as F. O. Bower, K. Goebel, G. Haberlandt, M. C. Potter, J. B. Farmer, F. W. Keeble, and others. In fact, while on leave in England in 1886, he was in part instrumental in obtaining from the British Association a grant towards equipping a laboratory at Peradeniya at which British and other visiting botanists were provided with facilities for their work.

Trimen died on October 16, 1896, having returned to Ceylon from leave in the previous year, against the entreaties of all his friends. He had by then become totally deaf and was also paralysed in one leg. He died, as he had lived, in single-hearted devotion to his work, almost his last moments of consciousness being occupied with attempts to write a few notes in continuance of his "Flora". His end has been most movingly described in the memoir by James Britten in the *Journal of Botany* for that year. In the country of his adoption, Trimen's early death was felt alike as a great loss to tropical botany and as the passing of a friend to all sections of the Ceylon public. Of him it could be said, in the words of the writer of a later commemorative article published in the Ceylon *Tropical Agriculturist*, that "a more obliging official, more attentive correspondent, or more pleasant friend and genial man than Dr. Trimen never came to Ceylon".

OBITUARIES

Prof. J. M. Macfarlane

PROF. JOHN MUIRHEAD MACFARLANE, emeritus professor of botany in the University of Pennsylvania, died at his home in Philadelphia a few weeks ago. He was born in Kirkcaldy in 1855, and his work was over more than twenty years ago. One or two old friends still remember him when he and they were boys in Edinburgh, where he learned his botany from "Woody Fibre" and from Alexander Dickson, and became one of Bayley Balfour's first assistants. It was under Balfour's influence that he wrote his once well-known paper on the minute structure of plant hybrids, which remained perhaps his chief work to the end. It was a careful comparison, within the histological limitations of its day, between the tissues of various hybrids and their parents, in such curious cases as the so-called *Philageria* (that is, *Lapageria* × *Philesia*) *Veitchii*, and the famous 'graft-hybrid', *Cytisus Adami*. This investigation led to his first appointment in the University of Pennsylvania in 1892, and gained him the Banksian Medal of the Royal Horticultural Society a little later on. His old master Dickson had been interested in pitcher-plants, and the Edinburgh Garden was rich in these, including the rare little Cephalotus and many hybrid Sarracenias and other things. Macfarlane had a note in NATURE on honey-glands in pitcher-plants, nearly sixty years ago. Long afterwards he did the pitcher-plants for various Floras, including those of British North Borneo and of New Guinea, and he wrote the chapters on Nepenthes, Sarracenia and Cephalotus for Engler. He was a very faithful and a very industrious man.

D'ARCY W. THOMPSON.

Capt. R. D. Williams

CAPT. R. D. WILLIAMS, officer in charge of clover breeding and other investigations at the Welsh Plant Breeding Station, died very suddenly while on advisory work in Carmarthenshire on October 7. He was fifty-four years of age and had been a member of the Welsh Plant Breeding staff since October 1920. His genetical work on *Trifolium pratense* in particular is well known through papers published in the *Journal of Genetics* and elsewhere, while on the more immediately practical side the Aberystwyth strains *S*.123 red clover, *S*.100 white clover and others bred by him are already grown and appreciated in Great Britain.

WE regret to announce the following deaths:

Dr. Edwyn Bevan, O.B.E., F.B.A., lecturer in Hellenistic history and literature in King's College, London, during 1922–33, on October 18, aged seventy-three.

Dr. W. H. Hatfield, F.R.S., technical research director of Thomas Firth and John Brown, Ltd., on October 17, aged sixty-one.

Sir Michael Sadler, K.C.S.I., C.B., formerly master of University College, Oxford, and, during 1911–23, vice-chancellor of the University of Leeds, on October 14, aged eighty-two.

Prof. Pieter Zeeman, For.Mem.R.S., formerly professor of physics in the University of Amsterdam, aged seventy-eight.

NEWS and VIEWS

British Drug Houses: Dr. Francis H. Carr

REFERENCE was made in NATURE of October 16 to the resignation of Mr. C. A. Hill as chairman and managing director of British Drug Houses, Ltd. Dr. Francis H. Carr has succeeded him as chairman of the firm. Dr. Carr has had wide experience in the fine chemical industry. He was educated at Whitgift School and Finsbury, where he was one of the first holders of a Salters Company's fellowship. He started his practical experience with Burroughs Wellcome, working with them during 1898–1914. He was with Messrs. Boots at Nottingham during the War of 1914–18 when he took an active part in producing for the first time in England certain chemicals which had hitherto been a foreign monopoly. In 1919 he joined British Drug Houses, Ltd., and has done his full share in bringing that company to its present eminence. Apart from his active business career as a technical chemist, Carr has been a leader in all that concerns the progress of chemistry in the outside world and unsparing in his efforts to put the profession on a high level. He has served as chairman of the Association of British Chemical Manufacturers and president of the Society of Chemical Industry, and has been active in innumerable other ways known to his colleagues.

Gift to the Royal College of Surgeons of England

THE destruction of the greater part of the historic Hunterian Museum of the Royal College of Surgeons of England by enemy action in May 1941 was a grievous loss of a national treasure house. This loss, however, has been a spur to the College to build up a worthy successor of the old collection. From the first it was determined that its Research Department, engaged in fundamental research work necessary for future surgical progress, should not be hampered in its work. This decision was followed immediately by a generous gift from the Bernard Baron Trustees to endow the chair of experimental surgery and so release general College funds for the reconstruction work. Now, when plans are being made for the restoration of the Museum, comes the news that two further gifts each of £100,000 from Mr. W. H. Collins have been made to endow the Departments of Human and Comparative Pathology and of Human and Comparative Anatomy. One of these gifts, that to the Pathological Department, is to be immediate, the other to mature after the death of the donor.

Mr. Collins in his letter announcing the gift to the president of the College, Sir Alfred Webb-Johnson, wrote: "Throughout my career I have realized how essential is the study and investigation of basic problems. Success of armies in the field is dependent on careful planning and preparation at headquarters, and victories in the war against disease can only be achieved by due application and increased knowledge of the fundamental medical sciences". No better dedication of a gift could be written and no better purpose could be served than to encourage the patient labours of those who lay surely the foundations on which others build. It is significant too that the donor expresses the hope that "the gifts will enable the Council to proceed with confidence with their responsible task and to engage the services of men of outstanding ability to assist them in their labours". In the post-war world of medicine in Great Britain the College will indeed have a unique place. Apart from its primary task of testing the fitness of those who aspire to practise the art and advance the service of surgery, it will have a special function in providing a link between the laboratory sciences and the treatment of the sick. Perhaps, too, in the future it will aspire to develop a hospital where discoveries at the laboratory bench will become quickly the triumphs of the hospital ward, and where the perplexing problems of disease will be brought rapidly to the attention of the laboratory worker. Cross-fertilization of ideas between laboratory and ward has already, in the association of the Rockefeller Hospital with the Rockefeller Institute in New York, produced advances in the science of medicine which have been of lasting benefit to suffering humanity.

Mr. Collins has been for many years a generous benefactor to hospitals in Great Britain, but his latest gift, far from benefiting but a few hospitals, will help to provide that new knowledge which is the free gift of medical research to all mankind.

Preservation of Museums in Italy

REPLYING to questions in the House of Commons, Sir James Grigg, Secretary of State for War, stated that an adviser is being appointed to deal with archæological questions such as measures for the protection and conservation of ancient monuments and works of art in countries occupied by British troops. Meanwhile British and American experts are already in occupied territory engaged in the supervision and protection of ancient monuments, museums, etc. The British officers sent or provisionally selected are from the British Museum, Inspectorate of Ancient Monuments (Ministry of Works), National Gallery and the Royal Institute of British Architects. Lists of æsthetic and ancient monuments have been prepared in Great Britain, and detailed instructions supplied to these officers regarding closing, guarding and, where necessary, repairing museums and similar institutions. Italian curators and their staffs, where suitable, are to be retained. In this connexion it is interesting to read Dr. G. B. Bidder's letter in *The Times* of October 14, in which he states that the aquarium in the Villa Nazionale of Naples, and so presumably the famous Stazione Zoologica Internazionale, is safe. Dr. Bidder adds that so lately as last August, the director, Dr. Reinhard Dohrn, was still in charge of the Station.

Anthropological Aspects of the Origins of War

A STUDY of the origin of war and its various manifestations from an anthropological point of view, by J. R. Swanton, of the Bureau of American Ethnology, which has been issued by the Smithsonian Institution in the War Background Studies series (No. 12), indicates the impossibility of separating the consideration of wars between tribes or nations from disturbances internal to them. Reviewing the various motives which lead to war and comparing warfare in simple and in advanced societies, Mr. Swanton emphasizes the relations between motives governing the individual and those which result in collective hostilities. These and further considerations of group controls, international relations, the effect of warfare upon trade and the place of the military establishment in the national life, lead to the conclusion that war is an expression of man's anti-social tendencies; and just as individual and collective crimes have to be controlled within the State by men trained and equipped to meet them, so the destructive threat represented by foreign armed forces when used for aggression must be countered by armed forces prepared to meet them. Between many nations there is a constantly increasing tendency to settle differences by peaceful means, and if these areas of law and of good feeling continue to spread, the preservation of order will pass more and more to the police, or to armed forces acting in that capacity. Consideration of the origins of war and attitudes towards it among different people shows that collective pugnacity is an acquired trait—cultural not biological. Fear and not hatred is the underlying if not the dominant motive, and when this fear can be allayed, belligerency will disappear with it. There is no mystery about the force required to terminate warfare. All that is needed is the will to do so.

A National Administrative Staff College

A SHORT statement, "A National Administrative Staff College", has recently been issued as a contribution to discussion by the members of a group which during the past twelve months has been studying this topic (honorary secretary, N.A.S.C., Norwich House, Southampton Place, London, W.C.1). The proposal is to found such a College to investigate and to expand the technique of organization and administration in civil life. To it will be admitted men and women aged about 28–34 who have shown ability and capacity in their particular spheres, including not only Civil servants, but also local government officers, men from industry and commerce, trade union officials and members of trade associations and professions such as medicine, the law, the Church and education. In addition to training such executives, the College will aim at promoting a better understanding of the inter-relation of the activities of the organizations from which its students are drawn, and it should also provide a centre for research into all aspects of administration. The curriculum will include a close study of the fundamental principles on which sound administration must be based, and an introduction to the many disciplines of which students must make use in their subsequent work. The whole course will emphasize the responsibility of leadership and the importance of correct practice in dealing with the central issue of human relations. The College will also endeavour to nourish the other qualities required in a leader—moral courage, judgment, energy, imagination. Probably not more than a quarter of the time will be devoted to formal instruction, and the fullest use will be made of modern methods such as the 'case' method. Fees per student would be about £30 per month, including living expenses and tuition. The group has already in draft a memorandum and articles of association, and is prepared to incorporate the College and to form an initial court of governors.

Eratosthenes and the Circumference of the Earth

In *Sky and Telescope* of September, under the heading "Saluting an Astronomer", Joseph R. Habes has an article which describes the method adopted by Eratosthenes for measuring the circumference of the earth. He knew that the sun threw no shadow at the summer solstice at Syene (the modern Assuan) and at the same hour at Alexandria the pointers of the sundials threw shadows, because Alexandria is north of Syene. He found that the arc of the shadow in the hemispherical bowl of the sundial was 1/50 of its circle, and hence concluded that the arc of the earth between Syene and Alexandria, which was 5,000 stadia, was 1/50 of the great circle of the earth. By this means he found that the circumference of the earth was 250,000 stadia, according to Cleomedes, but Strabo says that it was 252,000 stadia. A discrepancy arises when we come to consider the length of the stadium. The Greek stadium was 606·75 ft., and if Eratosthenes used this he was obviously very much in error in his computation. On the other hand, Pliny in his "Naturalis Historia" claims that Eratosthenes made 40 stadia equal to the Egyptian *schoinus*, and if this be so, taking the *schoinus* as 12,000 royal cubits of 0·525 metres each, the length of the stadium was 516·73 ft. If we accept the account of Strabo that Eratosthenes measured the circumference of the earth as 252,000 stadia, the circumference would be 24,662 miles, and the polar diameter 7,850 miles—only 50 miles short of the true polar diameter. This is considered to be one of the first great triumphs of scientific calculation.

Association of Scientific Workers : Scientific Film Group

In view of the rapid increase in the applications of photography in science and industry, the West Midland Area of the Association of Scientific Workers has formed a Scientific Film Group. By means of lectures, exhibitions and news letters containing abstracts of recent publications, the Group will provide information for scientific workers using photographic techniques in industrial processes and research laboratories. The Group will also foster interest in the manifold applications of photography. It has already set up an information service able to provide expert advice on all·aspects of photographic technique. The Group will endeavour to meet the demand of the general public for good-quality scientific films covering the whole field of science and technology. Monthly film shows will be held in Birmingham throughout this winter. The first show will take place in the middle of November. In the future the Group intends to produce original films and photographs. Applications for membership and inquiries should be addressed to Mr. H. Zerkowsky, Rowney Green, Nr. Alvechurch, Worcs.

Early Scientific Works

Catalogue 8, recently published by Davis and Orioli of 1 St. Martin's Street, Wallingford, Berks, contains a collection of 143 items printed before 1500. In addition to works on theology, philosophy and literature, heraldry and cookery, science and medicine are presented by the following works, among others : Albertus Magnus, "De secretis mulierum" (*c.* 1500) ; Aristotle, "De numero Partium" (*c.* 1490) ; Bartholomoeus Anglicus, "El libro de proprietatibus" (1494) ; Capillutus, "De curatione pestiferorum" (*c.* 1487) ; Celsus, "De medicina" (1497) ; Decembrius, "De Genitura Hominis" (*c.* 1495) ; Mesue's "Opera Omnia" (1497) ; Savonarola, "Practic in Medicina" (1498) and Silvaticus, "Opus Panectarum Medicinæ" (1498).

Announcements

Dr. B. A. Keen, assistant director at Rothamsted Experimental Station, will be absent from Rothamsted for approximately twelve months, acting as a scientific adviser to the Middle East Supply Centre, Cairo. He will report on the scientific and technical problems and resources (including personnel) in the area, and make recommendations on the establishment of a suitable organization, in the Middle East and elsewhere, to ensure the fullest practicable service of information and advice, with special reference to the post-war period. Dr. Keen will deal with agricultural resources and development and related problems, including education. He will be accompanied by Dr. E. B. Worthington, who will examine various non-agricultural matters. An American representative is expected to join the mission at a later date. The countries to be visited extend from Persia to Libya and from Turkey to the Sudan. It is hoped that the mission will be able to report by November 1944.

The following appointments and promotions in the Colonial Service have recently been made : P. S. Hammond, agricultural superintendent, Gold Coast ; D. K. McEwan Kevan, agricultural officer, Kenya ; W. V. Rose, agricultural officer, Nyasaland ; R. O. Williams, agricultural officer, Kenya ; H. B. Atkinson, inspector of plants and produce, Gold Coast ; G. G. Robinson, entomologist, Medical Department, Northern Rhodesia ; N. S. Stevenson (conservator of forests, British Honduras), conservator of forests, Nigeria.

The following appointments in the University of Sheffield have recently been made : Dr. A. I. G. McLaughlin (H.M. medical inspector of factories), honorary lecturer in industrial medicine in the Department of Public Health ; Mr. P. E. H. Howarth and Mr. R. E. Peasegood, temporary demonstrators in anatomy ; Captain J. H. Hale, assistant bacteriologist and demonstrator in bacteriology ; Dr. Enid Bankier, demonstrator in zoology to medical and dental students ; Mr. W. Davies, research assistant in refractory materials (in addition to his duties as temporary part-time assistant lecturer in geology).

The British Association of Refrigeration, at its forty-fourth annual meeting, has decided to change its title to the Institute of Refrigeration, the change to take place on March 26, 1944. At the same time, the Association will establish a qualified class of technical membership attainable by examination on the lines of the major engineering institutions.

R. J. Braidwood has issued as a reprint from the "1943 Britannica Book of the Year" notes describing recent archæological work in Iraq, Palestine, Kenya, Morocco, England, etc. The notes form an excellent and useful three-page summary of British war-time discoveries and publications in the realm of prehistory.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Relation of Nucleotides and Nucleosides to Proliferation-Promoting Factors produced by Ultra-Violet Irradiated Yeast Cells

Recent reports by Loofbourow[1] on the role of adenine nucleotides in wound hormone preparations from ultra-violet treated yeast cells prompt us to give a preliminary account of some of our experiments which bear upon the problem.

Adenine compounds were demonstrated to be present in the wound hormone preparations in the earliest studies[2], and the presence of guanine, although in smaller amounts, was also indicated[2]. On the basis of spectroscopic and chemical evidence, it was suggested that the purines were present in nucleic acid-like form, that is, as nucleotides. These findings were confirmed by Davidson[3] who showed the presence of purine nucleotides and nucleosides. Davidson also found a large amount of amino nitrogen. We demonstrated the importance of known yeast growth factors and amino-acids in the wound hormone preparations but showed that additional factors were also involved[4]. Loofbourow confirmed these findings[1].

In the present experiments, adenosine, guanosine and two samples of yeast adenylic acid were assayed alone and combined in concentrations up to 10 γ per ml. for their effect on the 24-hour yeast crop (*S. cerevisiæ*), using the previously employed[4] rocker-tube technique and Williams' medium[5] supplemented with inositol, thiamin, biotin, calcium pantothenate, pyridoxin, riboflavin, uracil, choline, acetylcholine, ethanolamine and nicotinic acid, as previously described[4], but substituting a casein hydrolysate for the amino-acid supplement. The nucleosides and nucleotides were also assayed in the presence of various amounts of a cell-free fluid from ultra-violet injured yeast suspensions. This fluid was prepared by washing 1·5 lb. of Fleischmann's bakers' yeast with 3 litres of distilled water, centrifuging, and resuspending in distilled water added gradually to a volume of 6 litres. The suspension was irradiated for 96 hr. with a quartz mercury arc during stirring and with the maintenance of constant volume. The suspending fluid was separated by centrifuging, followed by Buchner and Berkefeld filtration, and autoclaved, after which it was concentrated to convenient volume *in vacuo* and sterilized by autoclaving. Results of typical assays are shown in the accompanying table.

EFFECTS OF NUCLEOSIDES, NUCLEOTIDES AND 'WOUND HORMONE' ON GROWTH OF YEAST IN SUPPLEMENTED WILLIAMS' MEDIUM

24-hr. yeast crop, mgm. (dry wt.) per ml. (initial seeding, 0·03 mgm.).

Added substance (10 γ per ml. each)	Without wound hormone	With wound hormone	
		8·8 γ per ml.	140 γ per ml.
Medium alone (control)	1·05	—	—
Adenosine ($3 \cdot 7 \times 10^{-5}$ *M.*)	1·14	1·30	1·84
Guanosine ($3 \cdot 5 \times 10^{-5}$ *M.*)	1·11	1·32	1·66
Adenylic acid, I ($2 \cdot 9 \times 10^{-5}$ *M.*)	1·08	1·35	1·79
Adenylic acid, II ($2 \cdot 9 \times 10^{-5}$ *M.*)	1·04	1·35	1·75
Adenosine plus guanosine	1·41	1·53	1·73
Adenosine plus adenylic acid, I	1·33	1·47	1·79
Adenosine plus adenylic acid, II	1·36	1·44	1·79

Yeast nucleic acid (8 γ per ml.) was also tested but it was without effect and is not included in the table.

It is seen that adenosine possesses growth activity and yeast adenylic acid does not, confirming Loofbourow[1]. In addition, guanosine also possesses activity. Combination of adenosine with guanosine gives greater activity, as might be expected, but combination of adenosine with essentially inactive adenylic acid also gives increased activity. Addition of the wound hormone preparation, even in concentrations of the same order as the added nucleosides and nucleotides, produces additional growth. This probably means simply that optimum concentrations of the active substances were not present in the experiments reported and work is under way to ascertain whether this is so. The growth activity of the nucleosides accords with the finding of Englert[6] that yeast nucleic acid, normally inactive, acquires growth activity after subjection to alkaline hydrolysis.

Manometric studies were made, using 4 mgm. (dry wt.) of yeast per flask and adding the wound hormone preparation in quantities of 0·125–1 mgm. per ml. and the other substances in concentrations of 0·03–0·25 mgm. per ml. The wound hormone preparation caused a slight stimulation of oxygen uptake of yeast (10–20 per cent at the end of 1 hr.) in $M/15$ KH_2PO_4 containing 0·02 per cent glucose and in the supplemented Williams' growth medium, confirming an earlier observation[4]. The respiratory quotients, however, were lower than the control, even though the carbon dioxide output was raised in the latter medium. This appears to differ from Loofbourow's finding[1], but experimental conditions were probably different. The samples of yeast adenylic acid very slightly stimulated respiration in both media but did not raise carbon dioxide output in phosphate and raised it only slightly in Williams' medium, so that the R.Q. (respiratory quotient) was slightly lowered. Adenosine and guanosine had a slightly depressing effect on both oxygen uptake and carbon dioxide output in phosphate and caused a slight lowering of the R.Q. In Williams' medium both oxygen uptake and carbon dioxide output were stimulated somewhat, with the R.Q. scarcely affected in the case of guanosine and slightly raised in the case of adenosine. Yeast nucleic acid was essentially indifferent. All metabolic effects were relatively small. The R.Q.'s in phosphate on the whole were slightly above 1, while in Williams' medium, with an abundance of sugar, they usually ran in the neighbourhood of 6–7. We have shown previously that the oxygen uptake of our yeast is relatively unaffected by most of the bios components and amino-acids present in supplemented Williams' medium[4,7].

We have not had available a sample of adenosine triphosphate (ATP) and therefore have not been able directly to confirm Loofbourow's results[1]. However, in preliminary experiments which we are extending, we have applied a modification of Lohmann's fractionation procedure[8] to our wound hormone preparations. Assayed in unsupplemented Reader's medium the ATP fraction showed definite growth activity, as did the arginine phosphate and residual fractions. They all showed less activity than the parent extract, as would be expected from the previous findings and the assay conditions. Owing to the ease of hydrolysis of adenosine triphosphate it seems likely that our wound hormone extract would contain relatively small quantities of it as such. From the experiments it seems evident that fragments of the ATP molecule are active, and it may be that the phosphorylated adenosines (and guanosines ?) occupy a unique place n the control of growth, as suggested recently by Potter[9].

Recently, Leonian and Lilly[10] have stated that the yeast growth activity commonly attributed to unknown factors in yeast and tissue extracts is non-existent and may be duplicated by adding greatly ncreased quantities of certain members of the vitamin B complex (notably inositol, biotin and pantothenic acid) to the medium. In partial confirmation of this we find that tripling the quantities of these vitamins in our medium (that is, using per ml. nositol, 300 mgm.; calcium pantothenate, 360 γ; and biotin, 1·2 γ) raises our 24-hr. yeast crop from 1·05 mgm. to 1·6 mgm. in a typical experiment. However, further addition of the wound hormone preparation in quantities of 0·14 mgm. per ml., 0·2 mgm. per ml., and 0·56 mgm. per ml., gave respectively crops of 2·04 mgm., 2·28 mgm., and 2·46 mgm. Discussion with Dr. Lilly suggests that the difference between his finding and ours lies in the yeast growth period. In the 72-hr. period used by Leonian and Lilly the vitamins appear to obliterate the effect of other substances in the wound hormone and other extracts. This is not evident in the 24-hr. period used by Loofbourow and by us. It would thus appear that the additional proliferants (presumably nucleotides and nucleosides) in our preparations affect primarily the rate of yeast proliferation rather than the ultimate crop. This is also indicated by data of Loofbourow[1]. Experiments will be carried out to confirm this.

In summary, the nucleosides adenosine and guanosine, alone or combined with each other or with yeast adenylic acid, exert growth effects on yeast. Such substances, together with known growth factors, would seem to be present in wound hormone preparations from ultra-violet injured yeast cells. These substances exert a slight direct metabolic effect on yeast as observed manometrically. It is probable that these substances exert their effect on rate of yeast proliferation rather than on ultimate crop.

We wish to thank Sr. Mary of Lourdes McDevitt, I.H.M., for technical assistance, and Dr. C. N. Frey of the Fleischmann Laboratories for gifts of adenosine, guanosine and adenylic acid. The other sample of adenylic acid was purchased from Hofmann–La Roche as "adenosine phosphoric acid".

ELTON S. COOK.
SR. ANN GERTRUDE CRONIN, *S.C.*
CORNELIUS W. KREKE.
SR. THOMAS MARY WALSH, *O.P.*

Institutum Divi Thomae,
Cincinnati, Ohio.
Sept. 6.

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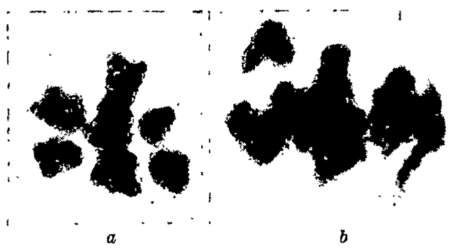
Chemical Nature of Chromosomes

THE staining properties of chromosomes have hitherto been regarded as due to their content of nucleic acid. Recently, however, Stedman and Stedman[1] have demonstrated the presence in animal chromosomes of a new protein, chromosomin, which they have shown not only to be the principal component of the chromosomes but also responsible for their staining properties. Part of their proof depended on the demonstration of the fact that when chromosomin, isolated from animal nuclei, is introduced into the dye solution formed by the interaction of hydrolysed deoxyribose nucleic acid and Feulgen's reagent (a solution which I propose to term 'developed nucleal stain'), it takes up the dye in exactly the same way as do the chromosomes. It is clear that if the Stedmans' interpretation of the mechanism of the normal Feulgen technique is correct, it should be possible to stain chromosomes directly with the developed nucleal stain. That this is the case is shown by the results, illustrated in the accompanying photomicrographs, which I have obtained with this stain on plant cells. This result provides confirmatory evidence of those of the Stedmans.



FIRST METAPHASE, (*a*) POLAR, (*b*) LATERAL VIEW, IN POLLEN MOTHER-CELLS OF CERTAIN SPECIES OF ALLIUM (FIXED IN ACETIC-ALCOHOL) STAINED WITH DEVELOPED NUCLEAL STAIN. × *c*. 1800.

The new process has certain advantages over other nuclear stains. A simple technique has been developed for its use, the details of which will be published elsewhere.

My thanks are due to Dr. E. Stedman for placing at my disposal the new stain and for his friendly co-operation.

H. C. CHOUDHURI.

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Edinburgh.
Sept. 28.

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A New Rapid Method for Penicillin Assay

VARIOUS methods of testing penicillin are in use in different laboratories, and while the accuracy of some of them is quite high, they all suffer from the disadvantage that some 12–18 hr. are required to obtain a result of any accuracy. Such a time-lag is a serious disadvantage in studying the production of penicillin—as the rapid change of *p*H which occurs under certain conditions makes it essential that harvesting should be carried out with the least delay if serious loss of activity is to be avoided.

The test outlined below, which has been in use for some time in these laboratories, has, in addition to its speed, other advantages. It is economical in space and materials, sterile technique is unnecessary and its accuracy appears to be as great as any other test. The test is based upon the inhibition by penicillin of the growth of a suitable group A β-hæmolytic Streptococcus—a 5 per cent suspension of washed sheep cells being used as an indicator. The penicillin to be tested is diluted to about 1 unit per ml. From this dilution quantities 0·20–0·10 are measured in 10 per cent steps, by means of a micrometer syringe, into 8 cm. × 1 cm. tubes containing 1 ml. of nutrient broth. To each tube is then added 0·2 ml. of a suspension of 500–700 × 10^6 organisms per ml. and 0·8 ml. of sheep cells. The tubes are then mixed by invertion and incubated in a water bath at 37° C. for approximately 3–3½ hr. They are then centrifuged and read for hæmolysis. A suitable standard and controls are included with each rack of tests.

The most critical factor in this test is the maintenance of the culture in a suitable state so that the suspension of organism does not contain any preformed hæmolysin. This is achieved by growing the culture on plain agar—and washing off with broth immediately before use.

URSULA WILSON.

Wellcome Physiological Research
Laboratories,
Langley Court, Beckenham,
Kent. Sept. 29.

Colour of Red Blood Corpuscles

IN a recent communication[1], Dr. J. R. Baker has asked why a single red blood corpuscle looks yellow instead of pink. Whether a thinned-out red colour is pink or yellow depends on the extent of its absorption in the blue end of the spectrum. Let us for simplicity regard white light as composed of equal parts of red, green and blue. Imagine two coloured substances with extinction coefficients as follows:

	Extinction	coefficients	
	Red	Green	Blue
Substance 1	0·3	0·7	0·7
Substance 2	[illegible]	0·7	7·0

At a certain thickness substance 1 transmits 5 per cent red, 0·1 per cent green and 0·1 per cent blue, while substance 2 transmits 5 per cent red, 0·1 per cent green and 0·00 per cent blue. At such thicknesses and above both substances transmit so little green and blue as to be red in colour. At a thickness about one fifteenth of this the proportions transmitted are—substance 1: 74 per cent red, 67 per cent green and 67 per cent blue; substance 2: 74 per cent red, 67 per cent green and 0·1 per cent blue. The colour of the first substance is 201 parts white (equal parts red, green, blue) and 7 parts red, that is, pink, while that of the second is composed of red and green which additively combine to give the sensation of yellow. If a different light source having a different red : green : blue ratio is used the tints will naturally be modified. The yellow colour of red blood corpuscles seen singly merely indicates the presence of a substance of high extinction coefficient in the blue region of the spectrum. The identification of a coloured substance is more satisfactorily made on the basis of its *absorbing* rather than on its *transmitting* qualities.

E. J. BOWEN.

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Sept. 18.

THE fact to which Dr. Baker directs attention can be readily understood if the absorption spectrum of hæmoglobin be considered in its entirety. In all the text-books attention is concentrated on the characteristic absorption bands in the yellow and yellowish-green, and the lower end of the spectrum is neglected. The very strong absorption in the violet, which helps to determine the colour of hæmoglobin at all concentrations, has therefore escaped the notice of many men of science.

A strong solution of oxyhæmoglobin absorbs completely all rays below the orange-yellow (585 mμ) and transmits nearly completely all those above it. The boundary (which corresponds to the upper margin of the α absorption band) is very sharp. The colour of such a solution is intense scarlet; on progressive dilution it changes through vermilion to a somewhat dull orange, and eventually to the pale straw-yellow of a single corpuscle under the microscope. The changes in the absorption spectrum that accompany these changes of colour are as follows. First a dim zone of transmission appears in the green, at about 505 mμ; its upper limit (the lower margin of the β band) is fairly sharp, but on further dilution its lower limit advances steadily through the blue-green and turquoise. Simultaneously with this extension a transmission zone in the yellow-green (560 mμ) appears, separating the α from the β band. The bands then become thinner and fainter, but at this stage absorption below the mid-blue (470 mμ) is still almost complete; and even at very high dilutions, when the β band is invisible and the α band very faint, absorption in the violet, below 425 mμ, is quite conspicuous.

Roughly speaking, therefore, one may say that a dilute solution transmits all but the violet and ultramarine; a solution of medium strength transmits the red, orange and much of the green and blue-green; and a strong solution only the red and orange. It is easy to understand that these will appear respectively pale yellow, moderate orange and intense scarlet.

Reduced hæmoglobin shows, as is well known, a single absorption band in the yellow-green, instead of the two of oxyhæmoglobin. This has scarcely any effect on its colour; its cherry-red hue at moderate dilutions, instead of the orange-vermilion of oxyhæmoglobin, is due to its much less vigorous absorption of the blue rays. But absorption in the violet is extremely strong, so that very dilute solutions have the same pale yellow colour as those of oxyhæmoglobin.

If, instead of diluting the solution, the depth of it through which the light passes is decreased, the results are exactly the same. It may be true of some dyes, as Dr. Baker says, that change of colour on dilution arises from molecular dissociation; but in most cases the explanation is analogous to that just given for hæmoglobin. This phenomenon of dichroism is much more widespread than is generally supposed. The most striking cases, such as chlorophyll and chlorocruorin, are well known; but the changes in hue on diluting methylene blue or copper sulphate (shift towards green) or erythrosin (shift towards orange) differ only in degree. Safranin, gentian violet, Bismarck brown and malachite green, which are respectively scarlet, violet, orange-brown and blue-green at moderate dilutions, are all deep ruby-red in concentrated solution.

The importance of dichroism in interpreting the results of colour tests on a microscopic scale is, as

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[1] NATURE, 152, 331 (1943).

Dr. Baker suggests, very great. Such tests should always be performed first on a macroscopic scale, with the concentration of one of the reagents low enough for the colour generated to be only just perceptible. If the coloured substance formed is dichroic there will be a change in hue as well as a decrease in intensity of colour, and a similar change may be expected on a microscopic scale.

D. A. WEBB.

School of Botany,
Trinity College,
Dublin. Sept. 21.

High-Angle Edge Flaking of Flint

THE communication by Mr. J. Reid Moir on this subject in NATURE of July 17 raises some interesting points.

The flint knappers of Brandon for more than a century past have severed their gun-flints from the parent flake at an obtuse angle platform-scar varying from 120° to 150°. Their blows, however, were delivered with an iron hammer on a flake held down on an iron anvil. The use of a punch enables a regular series of short scars to be formed at an angle of about 120°, as may be seen from the lateral edges of Danish axes. My own experiences in removing flakes by direct percussion forming platform-scar angles up to 140° were published in 1938[1].

Mr. Moir rightly states that the detachment of such flakes requires a heavy blow on a large nodule of flint. Palæolithic man apparently rarely used such blows, and usually only on the butt end of thick implements. Out of 1,800 measurements of platform-scar angles made in eighteen different human industries, only twenty scars were found with angles of 110° or more, or 1·1 per cent of the total. At the same time the percentage of angles of 90° and more varied from 0 to 18 per cent in the different industries, all the remaining angles being acute.

In flaked flints from Eocene deposits the percentage of high-angle flake-scars of 90° and more varies from 54 to 62 per cent. The age of these deposits rules out percussion by human agency.

In flaked flints of later Tertiary age from Puy Courny, the Kent Plateau, and below the Crag of Norfolk and Suffolk, the percentage of high-angle flake-scars of 90° and more varies from 62 to 70 per cent.

The high proportion of high-angle scars in the Tertiary flints contrasts sharply with the paucity of high angles in the human industries, and suggests that the Tertiary flaking was due to soil movement under pressure arising from solifluxion, foundering, or ice action. Laboratory experiments confirm the facility with which high-angle flake scars can be produced by rotating a flint edge under pressure against a hard surface.

ALFRED S. BARNES.

Dormers, Holwood Park Avenue,
Farnborough, Kent.

[1] Barnes, A. S., *l'Anthropologie*, 48, 222 (1938).

Identification of Male Schistosomes in Uncommon Sites

IN view of the difficulty of identifying adult schistosomes except by the shape of their *ova*, the presence of adult males in a site where only one species is known to occur strongly supports the opinion that the worms may belong to that species, even though easily identified adults belonging to another species are present in the same host.

Two adult male schistosomes were found[1] in a puppy's eyelid after it had been treated with cercariæ, some of which developed into typical adult examples of *Schistosomum hæmatobium* in the liver. These had probably migrated from the liver as the adults of *Schistosomum spindale* are wont to do before accumulating in the nasal veins.

Although nasal schistosomiasis has not been reported in South Africa, ova typical of *Schistosomum spindale* are found either entirely alone or in combination with *Schistosomum hæmatobium* ova in the human subject and the larvæ have been recorded in pond-snails[2], but variation in the number of testes in the adult males renders their identification difficult.

F. GORDON CAWSTON.

Britannia Buildings,
West Street,
Durban. July 24.

[1] Cawston, F. G., *J. Trop. Med. and Hyg.*, 28, 406 (1925).

[2] Porter, Annie, "The Larval Trematode found in Certain South African Mollusca with special reference to Schistosomiasis (Bilharziasis)" (1938).

The Welsbach Mantle

A THIN platinum wire immersed in flame gases acquires a temperature far greater than that corresponding to the mean molecular translational energy of the gases. The explanation appears to be that an abnormal dissociation exists in flame gases and that the products of the abnormal dissociation combine upon its surface[1,2]. This perhaps throws light upon the problem of the luminosity of the Welsbach mantle. A mixture of ceria and thoria in the Welsbach mixture proportions is an effective catalyst in the combination of hydrogen and oxygen[3], and it seems probable that when a mantle is immersed in flame gases high temperatures are reached at the active centres on its surface.

There is little or no abnormal dissociation in flame gases resulting from the combustion of over-rich inflammable mixtures[1,2], and it is of interest to note that the Welsbach mantle loses its selective radiating properties when placed in the reducing part of the flame[3]. The experiments of Nichols with niobium oxide show similar results[3].

W. T. DAVID.

Engineering Department,
University,
Leeds. Sept. 29.

[1] "The Abnormality of Flame Gases", *Proc. Inst. Mech. Eng.* (in the press).

[2] NATURE, 152, 278 (1943).

[3] Minchin, *Trans. Faraday Soc.*, 35, 163 (1939).

Bulb Correction in Capillary Tube Viscometry

IN a recent letter[1] Mr. A. C. Merrington points out that, when a material for which the viscosity decreases greatly with increase in rate of shear is investigated in a capillary viscometer, the resistance offered by the bulbs is a greater fraction of that offered by the capillary than when a true fluid is tested in the same apparatus. He thinks it possible that in some cases where anomalies have been reported in the relationship of flow-rate to capillary radius, the results can be completely accounted for by neglect of the bulb correction. He also thinks that in other instances it has influenced the results without being the whole cause of the observed anomalies.

The need for determining or eliminating bulb correction in accurate capillary tube viscometry is obvious. In the paper in which the radius anomaly known as the 'sigma' phenomenon was first described[2], we wrote:

"For this more accurate work with larger bulbs it becomes necessary to correct the pressures for the resistance offered by the bulbs themselves. For this purpose the bulbs are connected directly with one another, and the pressures corresponding to a series of volume-flows are measured. By graphical intrapolation the correction, P_b, corresponding to each volume-flow can be estimated. As no appreciable increase in resistance is caused by introducing a few millimetres of narrow tubing between the bulbs, it may safely be concluded that no kinetic energy correction is necessary with these measurements".

We should be surprised to find that neglect of bulb correction has been a serious cause of error in subsequent studies of the relationship of flow-rate to capillary radius, and we regard Mr. Merrington's suggestion as rather misleading.

R. K. SCHOFIELD.

Rothamsted Experimental Station,
Harpenden, Herts.

G. W. SCOTT BLAIR.

National Institute for Research in
Dairying,
Shinfield, Near Reading, Berks.
Sept. 16.

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[1] Merrington, A. C., NATURE, 152, 214 (1943).

[2] Schofield, R. K., and Scott Blair, G. W., *J. Phys. Chem.*, 34, 248 (1930).

University of London External Examinations and the Technical Colleges

WITH reference to E. B. Moullin's communication in NATURE of August 14, I should like to deal particularly with his statement that "All external examinations are abomination and an evil rot in an educational system". He cites as his chief authority for this point of view Prof. A. N. Whitehead. Prof. Whitehead was chairman of the Academic Council of the University of London in 1924 when I was chairman of the External Council, and he co-operated enthusiastically with me in creating a new department in external work. A sub-committee of the Academic and External Councils in July of that year brought before the Senate (March 27, 1924) a proposal for assistance to external students, which developed into what has become known as the "Advisory Service for External Students". Prof. Whitehead gave most generous help in the furtherance of this proposition, and it was his ardent advocacy that persuaded teachers (represented by the Academic Council) to give most disinterested and sustained support to the scheme, which was adopted by the Senate with only two dissentients. Prof. Whitehead continued to take the liveliest interest in the progress of the Service right up to the time of his resignation from the Senate to fill his new office at Harvard.

The Advisory Service has been in operation for nearly twenty years. Some of the most distinguished teachers in the University constitute a panel of advisers, and have given invaluable aid in preparing courses of study, furnishing guidance on authorities to be consulted, etc. The Advisory Service thus carried out by the closest co-operation between the two sides of the University of London received the special commendation of the Statutory Commission dealing with the reconstruction of the University in accordance with the University of London Act, 1926.

The part played by the external examinations of the University in raising the standard of teaching and achievement in university and technical colleges throughout Great Britain has been widely acknowledged by the colleges concerned, and in no faculty more wholeheartedly than in the faculty of engineering, to which the majority of technical colleges must be assigned. The encouragement thus given by the opportunity of sitting for external degree examinations in engineering has resulted in a steady multiplication of colleges throughout the country (now more than fifty in number), which have raised their standard of teaching to a level that allows of their recognition as institutions submitting candidates for London degrees.

If I understand Mr. Moullin's argument correctly, it is that every technical college should be sufficiently self-satisfied to disregard any outside valuation of its adequacy. Such an attitude does not show the humility which is surely one of the most authentic attributes of the truly scientific mind, and it is not endorsed by some of the most important university colleges in the provinces. Indeed, there is abundant evidence from many such institutions that the standard of their work has benefited by receiving the confirmatory hall-mark of unimpeachable authority afforded by the performance of their students in London external examinations.

In this connexion I may mention a tribute paid to the external side of the University of London by the late Frank Granger, vice-principal of Nottingham University College. He pointed out in a letter that lies before me that his own distinguished career had been rendered possible by the opportunity of taking an external degree at London, and he referred to the advantage enjoyed by his College which for more than fifty-four years had prepared students for London external degrees, and he mentioned that in the year 1935 in which he wrote, the fees paid by his students to the external side totalled more than £2,000, an authentic index to the volume of entries. He went on to say that other university colleges than his own were equally appreciative of the service rendered by London in this respect.

The service to higher education which the external side of the University of London fulfils may perhaps be gauged by certain figures.

In the latest list, given by the University Grants Committee, of students at Oxford, Cambridge and London, the following figures are furnished for 1941–42:

Oxford	2,723
Cambridge	3,245
London (registered external students) ..	10,799
" " internal " ..	9,162

The importance of the function discharged by the external system of examinations in fostering educational relations with our Dominions and Colonies was handsomely acknowledged by the President of the Board of Education (Lord Eustace Percy) in a memorable passage of his speech in the House of Commons on the Second Reading of the University of London Bill (Hansard, Nov. 19/26, col. 2122) with which I shall close this letter. Lord Eustace Percy said:

"It has been one of the great glories of the external side that it has been a pioneer in the effort to make London in a very real sense an Imperial University, and that is the position which London must increasingly occupy. The demand for university education in this country from all our Dominions is growing every year; Oxford and Cambridge clearly cannot satisfy it. The University of London is clearly marked out as the University that can satisfy it."

E. Graham-Little.
(Chairman of the External Council,
London University.)

House of Commons.

Importation of Technical Literature into Great Britain

About eight months ago, a copy of B. A. Soule's "Library Guide for the Chemist" was ordered for the Chemistry Library here, but so far the book has not arrived, presumably on account of its being an American publication. Everyone knows that in present circumstances, transmission of books from overseas must often be less rapid than in peace-time; could not some way be found, however, either to expedite transmission or to produce a limited edition of a useful work of this kind in Great Britain?

As most chemists are aware, almost all recent guides to the chemical literature are of American origin, and unfortunately few, if any, up-to-date British substitutes for these exist. Furthermore, on account of present conditions, many young chemists are being trained in a shorter time than is usual, and are being absorbed into industrial and other research laboratories without any previous research experience. This means that the training of these men in the full use of chemical literature can scarcely be adequately done at the university, and may, in extreme instances, be utterly neglected.

Since it becomes the responsibility of each man, after graduating, to continue to train himself in this technique—for without it he is defective as a research worker—it seems a matter of national importance that such aids as do exist should be made more readily available.

K. R. Webb.
E. W. Balson.
S. H. Harper.
I. G. M. Campbell.

University College,
Southampton.
Sept. 27.

Science, Christianity and Truth

In Nature of July 17 Prof. Julian Huxley directs attention to the misunderstandings of the scientific point of view involved in two passages from Rev. Hardwick's review of Canon Baker's "Science, Christianity and Truth". Surely these misunderstandings are in some measure due to the scientific man's habitual reluctance to state his own *credo*? In common with any other philosophical attitude, the scientific one must take its stand on some primary assumptions, whether they be regarded as beliefs or as merely postulates. Science assumes an objective universe external to an observer and that there is some real relationship between the sense reactions of the observer and the universe. These assumptions are implicit in the criterion of "arriving at truth rather than error" by the "correspondence with fact" to which Prof. Huxley refers. They are implicit, too, in the conception of evolution and all that is based upon it; among other things, a belief in an evolutionary trend towards betterment of some sort and in man's power of fostering and furthering that trend. Many scientific men hold these ideas and hold them as articles of belief rather than as mere working hypotheses.

Granted this, they have good ground on which to reply to the assertion with regard to their position in relation to liberty which Rev. Hardwick quotes with approval from Canon Baker's book. For evolution implies variation and variation implies liberty.

C. Berkeley.

The Biological Station,
Nanaimo, B.C. Aug. 23.

James Prescott Joule and the Unit of Energy

Prof. Allen's inquiries (Nature, September 25, p. 354) confirm the conclusion reached by the late Prof. Lloyd James and reported in the *Radio Times* in February 1933. He found that twelve near relatives and friends of the man himself pronounced 'Joule' to rhyme with *cool*, six more distant relatives and friends rhymed it with *coal* and nine other friends rhymed it with *cowl*. On the other hand, among living bearers or friends of bearers of the name, the frequency was ten for *cool*, twenty-six for *coal* and thirteen for *cowl*.

Thus it may be assumed that in Joule's time in Manchester, the name rhymed with *cool*, but that the present tendency is towards *coal* (which, for the sake of those with a desire for precision, is, I suggest, an attempt to represent the pronunciation which phoneticians would write as dʒoul).

J. H. Awbery.

11 Carlisle Road,
Hampton, Middx.

If Prof. Allen can establish beyond doubt that Joule pronounced his name *jool*, not *jowl*, he will do lexicographers a valuable service. The pronunciation *jowl*, given in "Chambers's Technical Dictionary", was based on information obtained for our much older "Biographical Dictionary", so there is no question of its being a recent corruption. While giving the pronunciation *jowl* for the personal name in our "Technical Dictionary", we were careful to give the form *jool* for the unit, since inquiry among physicists showed that it is now universally pronounced so. Accordingly the "contradictory statements" appearing in Prof. Allen's extract from our definition are in reality a measure of our compilers' zeal. It is true that a literal error has crept into the definition, which we regret; but we stoutly disclaim the error of a century in Joule's birth date.

W. & R. Chambers Ltd.

11 Thistle Street,
Edinburgh, 1.

May I hope that the "jool" pronunciation of Joule's name will be adopted, if only in order to preserve the mnemonic:

"Old Dr. Joule he made this rule:
The self-same energee
Which lifts a gram of matter to
42640 c. [centimetres]
Will heat a gram of water through
One centigrade degree."

This is due to the late Dr. T. C. Porter, of Eton College, and presumably gives the pronunciation current about fifty years ago.

J. B. S. Haldane.

at Rothamsted Experimental Station,
Harpenden.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX

ANNUAL CONFERENCE

THE eighteenth annual conference of the Association of Special Libraries and Information Bureaux (ASLIB), following the precedent of the seventeenth conference last year, was held in the Royal Society's rooms at Burlington House on September 18 and 19. The attendance was considerably larger than in 1942, and at some sessions the accommodation generously provided by the Royal Society was barely adequate for the number present.

The report on the year's work presented to the annual general meeting on September 18, when Prof. R. S. Hutton was re-elected president, referred to a steady increase in membership to 390 as against 328 in 1942 and 297 in 1941. Although the Association's income has increased, the increase of expenditure due to such special activities as publications and the highly successful special library-training course initiated as a result of a suggestion at the 1942 Conference, has led to a small deficit, and the financial position of the Association was the subject of some keen discussion at the final session of the Conference on September 19, when Miss Ditmas, the general secretary, gave an informal paper on "Aslib : What it is Doing and What it Hopes to Do". The report also referred to the project for a Union Catalogue of Periodicals in British Libraries, the Index to Translations, and to the use made of the location indexes to current copies of European periodicals, as well as to the visit of the chairman of council, Mr. Edward Carter, to the United States at the invitation of the Rockefeller Foundation.

Following the annual meeting, the Conference opened with an address on "Information Services for the Scientist" by Mr. J. G. Crowther, of the British Council. Pointing out that the forces now being released by the application of science are such that scientific workers can no longer remain indifferent to the use made of their discoveries, Mr. Crowther urged that the social situation demands that the instruments of modern science should be handled with knowledge and judgment, not only by scientific men but also by the community as a whole. Accordingly the efficient organization and use of scientific information are among the chief problems of the day. Britain, he considered, can have no future as a first-class power unless she modernizes her scientific and technical resources ; and in addition to making existing libraries as convenient and efficient as possible, plans should be prepared for an adequate national system of scientific and technical information. This is a necessary part of the development of an adequate national system of scientific and industrial research. Referring to his experience in the supply of information overseas regarding British contributions to science, Mr. Crowther commented on the need for better information services, on difficulties in dealing with bibliographic inquiries in science, and particularly on the need for carefully classified lists of books, coupled up with an index containing critical reviews. The centralization of abstracting services is also desirable ; further, Mr. Crowther directed attention to the absence of any British Government medical library comparable with that of the Surgeon-General's Office at Washington. Medical literature, too, is in urgent need of rationalization, and after a reference to the proposals for an Institute of Scientific Information ventilated at the British Association Conference on "Science and the Citizen" earlier in the year, Mr. Crowther suggested that there are so many problems of first-class importance in connexion with the organization of science and the development of scientific and industrial research, from the national, the Commonwealth and the international point of view, that the appointment of a Cabinet Committee to study the matter and inspire the preparation of suitable plans is desirable.

The remaining sessions on September 18 were devoted to a symposium on the international rehabilitation of special library services. Mr. Theodore Besterman contributed to the first session, which was concerned primarily with the tasks and policy in library rehabilitation, a paper in which he proposed the establishment of an international library clearing house. The centralized collection and allocation of books in some such way would be a valuable contribution towards the systematic restocking of libraries, and Mr. Besterman referred particularly to the question of periodicals. Emphasizing the necessity of a plan which transcends national boundaries, Mr. Besterman stated that the ideas embodied in his paper are being considered by a United Nations Committee under the auspices of the British Council, with Prof. Ernest Barker as chairman. Prof. J. Timmermans followed with a paper on the restoration of the Belgian public libraries, and the ensuing discussion centred largely on the possibility of using the services of the National Central Library for the purpose in Great Britain, assisted by a proportionately larger Government grant, and on Mr. C. C. Barnard's proposals in a letter to the Press last July (NATURE, **152**, 106 ; July 24, 1943).

A paper by Mr. E. J. Carter was concerned with the technique of the problem, particularly that of special libraries and information bureaux. As a background to that technique he visualizes a fuller organization of academic life. In each country the primary division would be into national academies in which the user interests of science, history, the arts and education have their centres. These would be more than professional societies as we have them in Britain now : they would be the central organizing and initiating departments of the whole of each sphere of national life, and would be academies of working scientific men, etc. Each academy would have its documentation section responsible for seeing that its members are efficiently served in regard to the collection, processing and distribution aspect of such service. The national academies would be linked up with Continental councils, grouped so as to yield as large units as could be functionally efficient. Some such background, he considers, is essential in any scheme for improving the details of communication.

Mr. Carter then briefly reviewed some of the needs, such as the organization, first on a national scale and then an international scale, of the collection, processing and distribution of knowledge, of which Mr. Besterman's proposal was only one aspect. The essential point both in abstracting and in documentary reproduction is to co-ordinate and extend existing services rather than to create new. Finally, the operation of an efficient information service involves both the education of the personnel required for the services we have in mind and the education of our own special public. In regard to the former, the whole of the service must be adjusted to the special needs of the studies and operations to be served, while in regard to the latter an information service which derives its life from its users either as contributors or as recipients is not a bureaucratic processing machine but a positive and creative element in national life.

These discussions were echoed in that following Mr. F. C. Francis' paper on September 19 on "The British Museum as a Special Library". Pointing out that the librarian cannot be content with cataloguing and classifying his stocks but must always be on the look-out for means to make his books known and to make them play their full part in the growth of knowledge, Mr. Francis explained how, broadly speaking, the British Museum has itself tended to specialize on subjects that might be roughly grouped as humanistic. It is the practice of the Museum to attempt to add to its collections 'English' books printed abroad, and also to buy books by outstanding writers, and really important books likely to be of historical importance in every field of knowledge. Scientific works published in the general proceedings of learned societies and academies, or in series, or as dissertations will, almost certainly, be found in the British Museum Library in complete ranges, as will the publications of foreign Governments, which again include works in all branches of study. Generally speaking, the collections are strong on the historical side of most subjects and weakest in modern foreign technical literature in non-humanistic subjects. Even here, Mr. Francis pointed out that of 112 items on pp. 226, 227 of the "World List of Scientific Periodicals", the British Museum has seventeen, the Natural History Museum Library five and the Science Library twenty-two, while of the seventeen, five are not to be found elsewhere. Similarly, out of 87 items on pp. 510–11, ten are in the Museum (and three only there), five in the Natural History Museum, and sixteen in the Science Library. Again, the Museum has no fewer than 111 items not included in the recent ASLIB List of Scientific and Technical Periodicals received from the U.S.S.R. during the period 1933–42. Finally, commenting on Mr. C. C. Barnard's suggestion, Mr. Francis urged that we should first carefully consider the place which each library, whether a national library or a special library, can take in a properly thought-out scheme devised to fulfil the tasks allotted to it as economically as possible. The organization of collecting so as to provide up-to-date, accurate and complete information on the subjects covered requires a measure of unified control if special libraries are not to be doing the same work, and he thought centralization rather than dispersal of our great reference library services should be the ideal.

At the following session, Major Irving J. Newman described the organization of American Photographic Information Services in Great Britain and included a showing of the film "Report from the Aleutians". The afternoon session of the Conference on September 19 was devoted to a discussion on the co-ordination of abstracting, at which Prof. R. S. Hutton presided. Referring to the earlier ASLIB discussions and inquiry on this question initiated in 1931, and to Prof. J. C. Philip's paper "Efficiency with Economy in Abstracting", Prof. Hutton suggested that the discussion should centre on such points as whether existing abstracting services adequately cover the delegates' field of interest, and whether there is duplication in their particular fields. If they run their own abstracting service, is that because existing services do not cover the field, are too slow or cannot cater for their special needs? Again, can a centralized abstracting service adequately serve their special field of interests or secondary interests indirectly related to their main field of research? The discussion was opened by Dr. S. C. Bradford, who put the case for a central abstracting service with his usual ability. Mr. King gave a brief statement of the steps already taken in regard to collaboration in the preparation of scientific abstracts arising out of the report of the British Commonwealth Science Committee. Despite a full discussion, it cannot be said that any tangible result was achieved. Most of those who participated appeared to be of the opinion that whatever centralized abstracting service may be organized, specialized abstracts will still be required to supplement it.

SCIENTIFIC STUDY OF THE AMARYLLIDACEÆ

THE American Amaryllis Society is again to be congratulated upon the publication of its ninth year-book "Herbertia" for 1942 (From the Society, Orlando, Florida, U.S.A. 3.25 dollars post paid). The Society, through its able editor Dr. Hamilton P. Traub, has brought together a large number of short contributions which deal with all aspects of the Amaryllidaceæ. Detailed descriptions of the Ixolirion tribe, with keys and descriptions of species, are given by Dr. Traub, and include chromosome data for *I. tartaricum*. The genus Crinum is also the subject of a comprehensive review by Dr. J. C. Th. Uphof. Suitable illustrations play a considerable part in the correct recognition of species, and Major Albert Pam of Broxbourne, England, has prepared an extensive check-list of coloured plates of amaryllids which have been published in the literature. A new species of Hemerocallis, *H. altissima*, is described by Dr. A. B. Stout, who also outlines the various stages in the breeding of a red-flowered day-lily. Starting with *Hemerocallis flava*, *H. aurantiaca*, *H. Thunbergii* and the Europa day-lily, hybridization and selective breeding produced the Theron class, with petals almost wholly red. Further breeding has made possible the introduction of bi-coloured flowers, and blooms with various geometrical arrangements of red upon a yellow ground.

Cytology of the genus Narcissus forms the subject of a paper by Dr. Abilio Fernandes of Coimbra, Portugal, who is a recipient of the Society's Herbert Medal. Chromosome numbers for fifty-seven species, varieties and forms, with information about the relative sizes of various pairs, are combined with more general considerations. Diploids, for example, do not grow on acid soils (pH 3·7–6·2), whilst hypotetraploids ($2n = 26$) can grow on soils of moderate acidity and on neutral and alkaline ones (pH 5·7–7·8). Cytological studies also reinforce the morphological subdivision of the genus into three groups. Some vitamins, hormones, pyrimidines and purines, with certain other substances, were found by Dr. F. T. Addicott to increase the percentage germination and tube-length of pollen grains of Milla sp. This fact should materially assist breeders to effect cross-pollination between varieties otherwise difficult of fertilization.

Virus diseases are also considered in the year-book. Earl Hornback lists the species of Narcissus in order of resistance to such maladies, placing *N. Tazetta* as most resistant, with double forms, Poetaz and Poeticus varieties as most susceptible. L. S. Hannibal finds, however, that not many other genera of the Amaryllidaceæ are affected by mosaic diseases. Several factors in the propagation of alstroemerids are of scientific interest. Alstroemeria seeds, for example, must have sun before they will germinate, whereas seeds of Bomarea must be protected from the sun, according to Harry L. Stinson. L. S. Hannibal shows, among other factors, that in the further treatment of seedlings, alstroemerias must not suffer any crowding of the roots, otherwise flowers will not be produced. Vegetative propagation of Hemerocallis by crown cuttings has been further studied by V. T. Stoutemyer, who finds that the cuttings grow much faster and make greater weight if they are given six hours extra light each day, than in conditions of ordinary illumination.

Other aspects of practical culture, of harvesting, storage, forcing and of garden combination are dealt with in the volume.

It is difficult to escape the conclusion that knowledge of the horticultural science, genetics and taxonomy of the Amaryllidaceæ has advanced more than that of any other group during the last decade. Perhaps it is because "Herbertia" gathers together all the items into a connected whole, but there is also the specialist stimulus provided by a Society bent upon the encyclopædic study of a relatively small field which is replete with garden beauty, world-wide in origin and distribution, and full of scientific interest.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Friday, October 22—Saturday, October 23

Town and Country Planning Association (at the Royal Empire Society, Northumberland Avenue, London, W.C.2).—Conference on "Country Towns in a National Planning Policy".*

Friday, October 22—Sunday, October 24

Institute of Industrial Administration (at the Waldorf Hotel, Aldwych, London, W.C.2).—Conference on "Management in Action".

Saturday, October 23

Sheffield Metallurgical Association, at 2.30 p.m.—Discussion on "The Education and Training of Metallurgists" (to be opened by Dr. Edwin Gregory).

Monday, October 25

Royal Geographical Society (at Kensington Gore, London, S.W.7), at 5 p.m.—"Flying Boats over Africa" (Kodachrome Film by courtesy of B.O.A.C., Commentary by Mr. Ronald W. Waugh).

Institution of Electrical Engineers (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Discussion on "How Far is International Standardization in the National Interest?" (to be opened by Colonel Sir A. Stanley Angwin).

Association of Austrian Engineers, Chemists and Scientific Workers in Great Britain (at the Austrian Centre Swiss Cottage, 69 Eton Avenue, Hampstead, London, N.W.3), at 7 p.m.—Mr. David Cushman Coyle: "The Tennessee Valley Authority—Democratic Planning of a Water System in U.S.A.".

Tuesday, October 26

British Society for International Bibliography (at the Science Museum, Exhibition Road, South Kensington, London, S.W.7), at 2.15 p.m.—Mr. H. Rottenburg: "The Universal Decimal Classification as the Keystone of the Publishing and Bookselling Business"; Dr. R. L. Sheppard: "The Bureau of Hygiene and Tropical Diseases".

Chadwick Public Lecture (at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1), at 2.30 p.m.—Miss Margery Fry: "Ill Health and Ill Doing".*

Eugenics Society (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Dr. A. Spencer Paterson: "The Size of the Family of the Business, Professional and Titled Classes"

Thursday, October 28

Oil and Colour Chemists' Association (Manchester Section). (in the Engineers' Club, Albert Square, Manchester), at 2 p.m.—Dr. W. J. S. Naunton: "Molecules without Tears".

Linnean Society of London (joint meeting with the Zoological Society of London) (at the Linnean Society, Burlington House, Piccadilly, London, W.1), at 3 p.m.—General Meeting; at 3.15 p.m.—Dr. J. F. G. Wheeler: "On a Humpbacked Whale taken in Bermuda in 1942"; at 3.35 p.m.—Mr. Gilbert J. Arrow: "Polymorphism in Giant Beetles"; at 3.55 p.m.—Dr. V. J. Chapman: "1939 Cambrid University Expedition to Jamaica".

British Institution of Radio Engineers (London Sectio (at the Institution of Structural Engineers, 11 Upper Belgrave Stree London, S.W.1), at 6.30 p.m.—Mr. John Logie Baird: "Colour an Stereoscopic Television".

Association of Austrian Engineers, Chemists and Scientif Workers in Great Britain (joint meeting with the Royal Nethe lands Institution of Engineers) (at the Institution of Mechanic. Engineers, Storey's Gate, St. James's Park, London, S.W.1), 7 p.m.—Mr. P. Kaufmann: "District Heating".

Friday, October 29

North-East Coast Institution of Engineers and Shipbuilde (in the Lecture Theatre of the Mining Institute, Newcastle-upo Tyne), at 6 p.m.—Dr. G. A. Hankins: "Experimental Fluid Dynami Applied to Engineering Practice" (Andrew Laing Lecture).

Saturday, October 30

Royal Anthropological Institute (at the Royal Society, Bu ington House, Piccadilly, London, W.1).—Centenary Meeting.

At 11.15 a.m.—Sir John L. Myres: "A Century of Our Work".

At 3 p.m. (at 21 Bedford Square, London, W.C.1).—"The Futu of Anthropology". (Dr. G. M. Morant: Physical Anthropology Prof. V. G. Childe: Archæology; Mr. R. U. Sayce: Material Culture Dr. R. Firth: Social Anthropology).

APPOINTMENTS VACANT

Applications are invited for the following appointments on o before the dates mentioned:

Educational Psychologist—The Director of Education, Municipa Buildings, Castle Street, Aberdeen (October 30).

Teacher (male) of General Science and Mathematics t students in full-time Junior and part-time day courses in the Colleg of Technology—The Director of Education, Education Offices, Rothe ham (October 30).

Horticultural Officer to take charge of advisory and demonstration work on commercial holdings and matters arising from th Horticultural Cropping Orders—The Executive Officer, Hampshir War Agricultural Executive Committee, The Castle, Wincheste (October 30).

Waterworks Engineer and Manager—The Town Clerk, Tow Hall, Halifax (endorsed 'Waterworks Engineer and Manager' (November 1).

Assistant Lecturer in Zoology—The Registrar, Universit College, Nottingham (November 1).

Assistant Lecturer in Agricultural Bacteriology—Th Registrar, University, Leeds 2 (November 6).

Professor of Engineering—The Registrar, University Colleg Singleton Park, Swansea (November 20).

Senior Lecturer in Electrotechnology at leading Technica College, Chile—The British Council, 3 Hanover Street, London, W. (endorsed 'Chile').

Assistant Engineer for the Government of Northern Rhodesi Public Works Department—The Ministry of Labour and Nationa Service, Central (Technical and Scientific) Register, Alexandra House Kingsway, London, W.C.2 (quoting Reference No. E.697).

Waterworks Engineer for the Nigerian Government Publi Works Department—The Ministry of Labour and National Servic Central (Technical and Scientific) Register, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. E.771).

Executive Engineer for the Sierra Leone Government Publi Works Department—The Ministry of Labour and National Servic Central (Technical and Scientific) Register, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. E.774).

Master of Engineering, whose main work will be the teaching c Engineering and the organization of Junior Technical Classes fo boys of 14 to 16—The Headmaster, The Gateway School, Leicester.

Civilian Technical Officer for a Government Department nea London with (1) expert knowledge of direct and alternating curren generators, regulating gear and switchgear, rotary and static converters, internal combustion engines, primary and secondary batteries radio communication senders, receivers and station accessories, telephone and transmission apparatus, including hand sets, carrier telephony and voice frequency telegraph equipment, teleprinter and cable laying plant, or (2) ability to assess modern designs of above equipment for maintenance spares—The Ministry of Labour and Nationa Service, Appointments Department, Q.S. 24, Kingsway, London W.C.2 (quoting Reference No. Q.16848).

For Government Posts in India—Industrial Planning Office (General), (Reference No. C.1911A), with sound mechanical training and at least five years' subsequent supervisory experience in recognize mechanical workshop: Design Officer (Reference No. C.1912A) first-class Mechanical Engineer with up-to-date experience in Desig of Light Mechanical Engineering Work; Assistant Industria Planning Officer (Ammunition) (Reference No. C.1913A), wit first-class mechanical training and knowledge of Modern Methods o Production and specialized experience in Light Press Tool Work an Machinery Components for Air Bomb; Assistant Industria Planning Officer (Non-Ferrous) (Reference No. C.1914A), with a least five years' experience in Production of Non-ferrous Metals an Alloys, and be familiar with Wire Drawing, Sheet and Strip Rolling and Sand Casting and Electrodepositing; Assistant Industria Planning Officer (Tools) (Reference No. C.1915A), with good experience in Machine Shop Process Planning and Jig Design experienc —The Ministry of Labour and National Service, Central (Technica and Scientific) Register, Alexandra House, Kingsway, London, W.C. (quoting the appropriate Reference No.).

University College of Science
Dept.
92, Calcutta

NATURE

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EDUCATIONAL RECONSTRUCTION (4)

ADULT EDUCATION

ONE section of the White Paper on Educational Reconstruction, even at this stage, has caused considerable disquiet. That is the portion dealing with adult education. While the White Paper tells us that "without provision for adult education, the national system must be incomplete", there are few indications to show that the Government has any ordered policy for adult education. One cannot avoid the feeling that the paragraphs on adult education have been inserted diplomatically in order to assuage potential critics. There is little doubt, however, that it has had the opposite effect, and the concerted powers of adult educationists are being mobilized to persuade the Government to reconsider its attitude. That they will need as much support as possible may be deduced from the significant fact that in his amplifying statement when the White Paper was presented to Parliament on July 29, the President of the Board of Education made no specific reference to adult education.

To-day, some 80 per cent of the population of Britain left, or are leaving, school at fourteen years of age. That can scarcely provide adequate equipment for the citizens of a democracy ; and even this contracted education has in many cases been badly interrupted by the War. Yet these boys and girls who have left school at fourteen will be the majority of the electorate during the next thirty years ; the twenty-two million people who are already adult will decide the success or failure of the post-war social order. The educational provisions made for them may be indirectly the dominant factor in building the new educational order for children and young people adumbrated in the other parts of the White Paper. Yet the total additional expenditure which the Board is prepared to make during the first eight and a half years after the end of the War on technical *and* adult education is less than two and a half million pounds. No indication is given how much of this will be available for adult education alone. "Although the development of technical and adult education is not included among the matters to be dealt with in the first four-year plan, some allowance has been made for preliminary expenditure in respect of technical education." This can scarcely be said to be in tune with the high-sounding phrases in the White Paper about the value of adult education.

It must be brought home to Parliament before the Education Bill is discussed in the coming months that to neglect the education of adults will constitute an omission difficult to correct at a later date and one which will have profound significance in establishing a settled peace. The White Paper states that "it is only when the pupil or student reaches maturer years that he will have served an apprenticeship in the affairs of life sufficient to enable him fully to fit himself for service to the community. It is thus within the wider sphere of adult education that an ultimate training in democratic citizenship must be sought". Democracy and education go hand-in-hand, and a belief in one implies a belief in the other. This truism has been so frequently stated that one is inclined to repeat it mechanically, and the pregnant meaning it contains passes unnoticed.

The case for the democratic faith has recently been skilfully presented by the Sub-Warden of Wadham College. The simplest description of democracy, Mr. Leonard says, tells us that it means government by the process of "counting heads instead of breaking them". A democratic outlook acknowledges that reason and not passion is the light which should illumine the pathways of human progress. It maintains that men, for all their faults and failings, are in fact sufficiently reasonable and sufficiently sociable to make it possible for great States to be ruled by those peaceful and reasonable means which we call parliamentary government. The subjects of a State form one people and should share in its government; no minority must be outlawed or outraged; minorities can accept the decisions of a majority because the majority will treat them with consideration and not drive them into disloyalty.

If we accept this as a reasonable description of democracy, we can see that there is an inviolate connexion between democracy and education, and particularly adult education. Using the methods of argument and reason, and requiring a consideration of minorities such as men will show only if they can understand and appreciate points of view which are opposed to their own, democracy needs an educated people, and cannot develop to maturity until a truly educated outlook is more general than it has ever been in human history. (It is not inappropriate here to recall that the cleavage between democratic and totalitarian States broke up the international relationships of scientific men long before most people believed that it must inevitably end in war.) While it is true that real adult education can only thrive in democratic soil, one must realize, too, to change the metaphor, that the sounding-board of a democracy is the quality of its adult education.

All modern States, whatever their form of government, must strive to maintain and improve the level of scientific and technical knowledge. Only in a democracy will there be a concern for the free development of cultural standards through ample provision for adult education. With trepidation one considers the prospects for democracy in Great Britain during the next 20–30 years if no more attention is paid to adult education than is indicated in the White Paper.

Adult education should aim at building up the resistances of people against the powerful influences of propaganda and advertising, and here training in scientific method would be invaluable. The ability to view facts objectively, to form judgments without reference to what one desires (or fears) to find, or to any kind of personal valuation, has taken centuries of mental discipline to achieve and has become one of the basic factors in Western civilization. It is a method which needs more and more adherents, and these are only likely to be found if increased attention is paid to the education of students mature years.

It has already been pointed out that adult educat has striven almost alone to remedy for hundred thousands the deficiencies of an educational sys which ended for them on their fourteenth birthd Adult education has also had tremendous influe in creating a public will calling for wider and wi educational facilities for the new generation. It also left its imprint on the universities, and ind rescued some of their members from the danger unreality of academic aloofness. Further, thro adult education, the teacher has been saved from exclusive role of instructor, which must inevita leave a mark on his own character, and has of been placed in the position of a leader of discuss in which direct interchange of views occurs.

What can be done to cater for those who h already left school or will leave school during 20–25 years before the other proposals in the W Paper begin to take effect? Does the Governm fully understand how much life in the Serv has contributed to adult education, and what fe soil awaits the implanting of its seeds? Have t realized that Service life itself is a powerful addi to one's knowledge of the art of living, and that communal life of a barrack-room or mess is a sh educational corrective to one's own experience the place of individuals in society.

Everyone in the Services is familiar with numberless 'courses', and few people will not b been sent away at short notice to be given a pe of instruction at a centre where living in commu is the usual and accepted method. In the Royal Force these courses have often meant reside abroad, while both the Royal Air Force and Royal Navy are to-day sending men to the uni sities for six-month courses, during which time t live and study as ordinary undergraduates. I worth noting that about half these airmen sailors are taking courses in humane subjects—hist economics, philosophy, etc.—which can serve immediate utilitarian or vocational ends. Thous of men and women have passed through Mini of Labour training centres and many thousa have taken part in residential courses for yo leadership, some of them lasting so long as thirt weeks.

Besides all this there are the educational sche of the Services, which have become the grea development in adult education we have yet se Much of this work is carried on within the un but a great deal of it takes place during periods w Service men and women go into residence at universities for periods varying between a few d and three weeks. The majority of these courses h been framed to make the students more aware their responsibilities as citizens. Can we afford let this highly important field of work remain un tivated at the close of hostilities? What can be d in war should not be impossible in peace.

For all people, life is only beginning at eight

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*Nature, 151, 438 (1943).

nd for most of them it is after this age that interest wakens in the deeper issues of politics, morals, science, religion and so on. The Scandinavian countries have recognized this and have provided ome two hundred adult education colleges for their sixteen million inhabitants. In Great Britain, to which the oppressed and subjugated peoples of the Continent nd elsewhere will look for a strong and inspiring ead in the post-war world, there are nine residential olleges, of which seven are grant-aided. The total number of students in residence in these grant-aided colleges is about three hundred.

The case for residential education has been well put in recent publications of the Educational Settlements Association and is admitted to be desirable in the White Paper. The value of uninterrupted study in congenial and agreeable surroundings, undisturbed by vocational, domestic or other preoccupations, will be evident to all who have had to rapple with the limitations of evening classes. There is the additional stimulus of sharing the pursuit of knowledge for cultural ends in community with other students of like mind and interests; the merits cannot be stressed too highly. It presents a training in democratic living which would be difficult to get by any other means, while the recuperative and recreative effect of a period of withdrawal from the stress and strain of everyday life and employment is too well known to need amplification. This uggestion has received considerable backing from the Trades Union Congress. "The most serious onsideration ought to be given to the possibility of nstituting in this country a system of short-term residential study for adults. The Government should ive a lead to employers to release workers for this ind of short course, with an assurance of reinstatement on their return." Residential colleges of diverse types that are already in existence in Great Britain ave demonstrated the potentialities of full-time study in residence and indicated the latent demand. If the Government intends the reference to residential colleges in the White Paper to stand for omething more than a political sop to their protagonists, it will have to provide for the purpose omething more concrete than the financial proposals et out therein.

In addition to residential colleges for full-time education, there will be needed many non-residential nstitutions for part-time or leisure study. This is dvocated in the White Paper. "There will need to be developed appropriate centres, which will not only provide the educational courses which the adult population may need, but will add to them the values associated with the life of a corporate institution". These should offer a suitable environment for the individual and social development of adults. The smaller citizen centres, of which Sir Richard Livingstone has been a leading advocate, would be admirable or the purpose until the larger all-embracing community centres could be provided. Citizen centres would be modelled on the lines of the educational settlements, of which there are nearly thirty in Great Britain at present. These provide a building which serves as a common hearth and home for all grades of students and other people engaged in social and educational activities in the neighbourhood. The citizen centre has much to offer to the development of adult education, and its place in the national system of education is one that needs earnest consideration.

For whom should adult education cater ? There are those who say that we should not in any way pander to people who can only be attracted by the superficial and meretricious, and that we should cater only for students of good intention*. Yet with all the powerful resources at their disposal, the voluntary organizations connected with adult education before the War could do no better than enlist 3 per cent of the possible field of recruitment. It is unfortunate that their admittedly wide experience has led some of the voluntary organizations to believe that they hold a vested interest in adult education and that theirs is the only adequate method of diffusing culture to adults. One is not unmindful of the great danger of promoting a semi-education which might become superficial and dilettante, but methods of 'popularization' will have to be extended if we are to draw a near maximum number of students into the world of more serious pursuits. It would be a pretence to suggest that the work carried out in air-raid shelters by the Workers' Educational Association has been of a very formal nature, and yet it has made a notable contribution to the methods of providing educational opportunities for adults.

The experience of the voluntary organizations has shown that the effective demand for the more serious 'tutorial' classes is limited. The problem to-day is to provide for a wider constituency without diverting the serious student from the type of class from which he will gain most benefit. Both types of students will be catered for only if the two main principles of adult education survive—voluntary attendance and free discussion. Above all, one must remember that the most important influences brought to bear on the adult citizen are not through education in the narrow sense, whether formal or informal. The part played by the Press, radio, the film, pamphlets and books is beyond measure.

In industry, besides the education which can be called technical and which is designed exclusively as a means of training people for earning their living, much is being done to raise the cultural level of the masses. Many big industrial organizations, for example, provide lunch-hour programmes which are an attractive feature of the winter's educational programme. These have often been the means of stimulating a more serious interest in subjects for which formerly the individual had little concern. The educational organizers in industry have excellent opportunities for promoting educational work with adults, and it is encouraging to note that their numbers are increasing.

From the foregoing it can be seen that the main problems of adult education have yet to be resolved, and a tremendous volume of research needs to be undertaken. In a democracy, the utmost variety of educational activities is essential. Ideally, there should be a different educational provision for every student, and it is not beyond the bounds of possibility that one day this will be achieved. Meantime, it is hoped that the proposals made by the Board of Education to encourage educational institutions for research will be used to a considerable extent in the wide and exciting field of adult education. The White Paper suggests that a maximum of £100,000 a year should be spent on educational research. Compared with the amount spent at present, this appears to be a reasonable sum. When viewed against the human problems that need urgent investigation, it seems as inadequate as the other measures proposed for adult education in an otherwise well-designed White Paper.

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*Nature, 152, 359 (1943).

INDUSTRY AND SOCIETY (2)

RELATION TO GOVERNMENT

THAT there must be some measure of public control of industry is not now seriously disputed. It is accepted explicitly by Mr. Samuel Courtauld in his valuable paper "Government and Industry: their Future Relations", and also in the Unilever Paper on unemployment, which, however, points out that this does not necessarily imply direct control, since the Government already possesses powerful indirect means of control. Production must be adjusted to human needs, not human needs to production, as has too often happened when industry has lost sight of the essential purpose of economic activity. Fundamentally, it might be said that government intervention in industry should be no more than to ensure that economic aims are subordinate to wider social purposes, and to create the conditions in which the desire to make industry a form of essential social service can best develop. It is not a question of size but of direction and fitness for the purpose. The big business may, as Lord McGowan points out, be essential for some purposes; for others the small unit may best serve our end.

When we come to the methods by which that public control is to be effected we have already a wealth of experience on which to call. Of this Madge's book gives an admirably concise survey, if necessarily much less comprehensive than is given in the two chapters on British experience in the regulation of business in Cushman's "The Independent Regulatory Commissions". The question is whether with all this wealth of experience we can agree to think together, as Dr. Barker says, about a solution of economic problems which agrees with the logic and character of our democratic community.

The amount of common ground in the numerous statements and reports which have appeared on this question of government and industry give real reason for hope of a solution by the democratic process of discussion and compromise, provided the issues are clearly seen and the fundamental principles applied to test the soundness of each solution proposed for a particular problem or industry. Here once again Dr Barker is an invaluable guide. The issues of common life, he reminds us, do not exist in themselves or in things which can be done and then put away. They exist in persons, and are rooted and grounded in opinions and feelings. The reorganization of industry is really the reorganization of human beings, th redirection of their opinions and feelings. The action of government is fundamentally a psychological readjustment of the opinions and sentiments of human subjects, and no government can deal promptly and successfully with these real issue unless it knows at first hand the opinions and sentiments which constitute the core of those issues, and unless it periodically renews its knowledge to meet the constant renewal of these opinions and sentiments That is the fundamental justification of the democratic process, and the reason for believing with Dr Barker that the defects of business enterprise are due to the absence or imperfect development of th methods of open discussion and voluntary agreement which have been so highly developed in the State.

While there is no escape from the necessity o planning in the field of economics, planning enhance the importance of a democratic system of government. It is the essential corrective if human value and a sense of perspective are to be preserved, and in itself prevents planning going to the extreme limits seen in the totalitarian regime. Prof. Zweig in his book "The Planning of Free Societies", note that all planned economies have so far failed in practice to establish a real and successful self-government His appreciation of the work of the Tennessee Valley Authority and analysis of the causes of the failure o the American experiment in the self-government o industry under the New Deal are as pertinent i this connexion as his final review of the conditions for the proper working of planning.

Planning is not a franchise or immunity which lie outside the jurisdiction of free discussion and voluntary compromise. It requires efficient preparatio by research and investigation. Its objectives should be limited and clearly defined, for it is a powerfu implement which should be used with the greates care and foresight and applied only so far as is necessary; its abuse may easily destroy the most precious values. To employ the minimum measure of contro to achieve a given objective should be the supreme aim, and therefore planning should be restricted t general control.

As Dr. Barker points out, if the State itself forms economic organs such as an Economic Council or Council for Industry, it does so to facilitate the reconciliation and adjustment of claims and counterclaims prior to the action of the State, to promote the self-planning and self-discipline which are also integra to the economic system, and to achieve fuller and more informed discussion; and not to devolve upo them the burden of decision. When the leaders directors and experts in the various economic fields are encouraged to do the work of self-planning, tha work is not remitted to their unfettered discretion. The democratic State does not release economic self-planning and self-government from their necessary immersion in the general and total flood of political self-government. All economic planning must be compatible with the liberty of a general society of free minds, and statesmanship must ensure that short-term planning is restricted to its own proper issues and the long-term mode of planning, with its restraints on the distant future, reserved for the great issues which demand its operation.

These considerations suggest that the question of the relations of government and industry is really one of developing good tools of procedure and using them well. Fortunately we may read much encouragement in this respect in the Nuffield College Statement on "Industry and Education" and in Mr. Madge's survey, "Industry after the War". It is implicit in the distinction drawn between three main classes of industry and enterprise that we should choose the tools appropriate to the particular task. First, there are the key enterprises such as the basic utility and transport services. Secondly come major industries occupying vital positions in the nation's economy and apt to fall under monopolistic or semi-monopolistic control, and thirdly there are industries of smaller or medium size to which these conditions do not apply.

For the first there is general agreement that the appropriate form of control is a public corporation, combining a high degree of independence in operation with the necessary safeguarding of the public interest by remote public control. Such control may vary widely in type, and each key industry will require treatment appropriate to its special operational conditions. While the only extension proposed by the Nuffield College Statement for the public corporation is that of transport, it is made clear that the principle is capable of further application, and a timely warning is uttered against the danger, in establishing new forms of industrial organization, of treating as static a fluid situation. Every care must be taken to avoid impeding structural change due to the development of new techniques, or to give a group of producers any vested right to impede the growth of new processes either within the industry itself or outside.

For the second main group of industries the statement proposes the establishment of industrial boards. These would be statutory bodies presided over by chairmen appointed and paid by the State. These boards would be responsible, in consultation with the economic organs of the government, for the formulation of general economic policy for the industries concerned, interpreting the State's requirements to the industry, and the requirements of industry to the State. Consisting mainly of representatives of the industry, including those of labour, they are conceived as a measure of industrial self-government which will promote efficiency while safeguarding public interest, in particular against monopoly. They aim at throwing on industry the responsibility for conducting its own affairs under adequate safeguards for the public interest.

These proposals would go far to meet the dangers to which attention has been increasingly directed of late. They bear some resemblance to the tribunals proposed in 1919 by the Report on Trusts, when the public interest is adversely affected by monopolist organization. The statement is even more explicit on this point in a further section. It advocates dealing drastically with forms of profit-maintenance which result in the indefinite survival of inefficient producers, as well as in unduly high profits for the more efficient. The inefficient producer, unless he is made efficient, must go, subject only to the need for spreading the disappearance of uneconomic enterprise over a period long enough to avoid serious hardships or widespread unemployment.

There are other suggestions with regard to machinery of government in the Nuffield College statement which deserve note. The importance of substantial changes in the recruitment and organization of the public services and in the methods of industrial administration is stressed. Apart from the development of a technique of control and administration which will be effective and reasonably simple both from the point of view of the business man and of the Civil Service, it will in effect be necessary to develop a kind of public administration to deal with the State's new and expanding functions in the industrial field. This in turn involves recruiting new types of men and women, and once again we find emphasized the importance of closer assimilation between the rates of salary paid in public and in private business, of encouraging freedom of movement between publicly and privately administered concerns, of ensuring that technical as well as administrative ability is given the fullest recognition and scope, and of attention to the right training of those who are to enter the service of industry and commerce.

Further, public enterprises, urges the statement, should be so managed as to cover costs, including a reasonable return on their real capital assets, and where any element of subsidy is deemed necessary in the public interest, it should be open and not concealed. To avoid undue rigidity the managerial and technical staffs of public industrial enterprises should not be called upon to work under Civil Service conditions or be given similar guarantees of permanence, although the arrangement of pensions schemes so as to facilitate migration into and out of the public services is advocated. Similarly, the highest administrative positions in all branches of the public industrial services should be effectively opened to all possessing the right personal and technical qualifications, and should neither be the preserve of a particular administrative class nor closed in practice to the best men by inferior standards of remuneration and conditions of employment. Once again we encounter the suggestion of the constitution of standing parliamentary committees as a means of making parliamentary supervision of economic policy more practical and effective, a suggestion which merits more solid reasons for negation than the Government has yet given in Parliament. The publication of informative accounts is only one of the further measures which the statement suggests to encourage confidence in the integrity of industry and to overcome past prejudices.

The resemblance between this picture of the relations between government and industry and the practical target outlined by Mr. Madge is striking. Mr. Madge visualizes a Minister of Production, but with extended powers and functions more clearly defined, and assisted by both an executive staff, drawn largely from men with experience of the productive side of industry, and a research and advisory staff, to survey industrial problems and draft plans for their solution. Members of this section should not be permanent members of the Civil Service, but drawn from the ranks of management, the professions, the trade unions and the universities. Use would also be made of independent research work in the universities and elsewhere. A similar proposal has since been advanced in the report of the Sub-Committee of the Liberal Party.

Under this government machinery there would be three types of industrial organization, all of which would be given a fair chance to prove their worth : State-owned and State-managed ; privately owned with some or all directors appointed by the State ; and privately owned and privately managed. In some industries all three methods of control and management might be used experimentally ; in others a whole sector would be State-owned or privately-owned. Provision would be made in all types for joint consultation with labour on labour questions and other matters both at the works and at the national level, and books and records should be open for inspection by the research and advisory section of the Ministry of Production, which would review the efficiency of these methods and make its findings public. It will be noted that Lord McGowan recently advocated a step in this direction in recommending the registration of every international trade agreement with the Board of Trade, so that the Government would possess a complete picture of British participation in cartels.

What is hopeful in this whole approach is the emphasis laid on co-operation and a new spirit in industry. Machinery, either in the mechanical sense or in that of organization, is not enough. True it is that there are severe limits to the extent to which industrial democracy is practicable. The number of those sufficiently interested, apart from the question of technical qualification, to take any continuously active part in the management of an industry and the determination of working methods and conditions is relatively small. But while it is important to do everything possible to provide outlets for originality, energy and organizing ability, and to imbue all members of an industry from its directorate downwards with the spirit of public service, it is important that the humblest workers should feel that they have the opportunity to rise higher according to their ability, that their treatment is fair, and that their work provides worth-while opportunities for human energy and skill. If we succeed in this, it will matter little to the workers in any industry that general policy and technical control must be ordered from above. Secure that policy and control are ordered in the general interest of the community, they will recognize that power as legitimate power, and find in their occupation once more the social satisfaction which is the basis of a functioning society.

It should be noted that the Nuffield College Statement looks to social security legislation on the lines of the Beveridge Report as providing a necessary foundation for better industrial relations as well as to this greater publicity, and its concluding emphasis on the key factor of management and the powerful reaction of the situation on the position of managers and technical staff will be noted by scientific workers.

The fuller recognition of industrial management as a skilled profession, requiring both high personal qualities of enterprise and imagination and appropriate forms of special training, should not only improve the technical efficiency of industry but also foster good relations among all who are partners in the work of production. Moreover, the more industry becomes a partnership of all grades and sections of those engaged in it, the greater become the demands upon its managers for skill in the democratic handling of men as well as in the technical sphere. But even the question of closer collaboration between industry and education is secondary to that of collaboration between industry and the consuming public, and between those responsible for the direction and management of industry and those they employ. All engaged in industry must put first in their relation to industry the aim of serving the public, so that no question of sectionalism or exploitation can arise to disturb the confidence and good relations existing between industry and the rest of the community.

CHEMICAL PHYSICS: THE COMMON THEORETICAL BACKBONE OF CHEMISTRY AND PHYSICS

Introduction to Chemical Physics

By Prof. J. C. Slater. (International Series in Physics.) Pp. xiv+521. (New York and London : McGraw-Hill Book Co. Inc., 1939.) 33*s*.

A WORD of apology is due to this book and its author for the delay in this review. The review copy was received by the reviewer just before he started for Canada on a liaison mission which lasted some ten months. On his return the book was overlooked until recently, when, during a prolonged period of leave, it was found and studied with avidity, and the writing of this notice at last undertaken. The book is excellent, and, no matter how great the unfortunate delay, deserves a proper notice in the columns of NATURE.

What precisely is 'chemical physics' ? The author gives one answer in his preface which the reviewer willingly accepts. One may define, roughly, chemistry as the science of atoms and the way they combine, and physics as the science of interatomic forces and the large-scale properties of matter resulting from ose forces. One may even deplore, nowadays, at physics and chemistry were ever separated, ough one must admit that prior to the developments f the last forty years such separation seemed natural nd necessary. But the tendency both of theory and f experimental technique has been to emphasize e oneness of the science of the properties of matter, f which chemistry and physics are two most intimtely linked branches, with a very wide range of udy in common. To stress the importance of this mmon field in which both chemists and physicists ust be trained, it is useful, and indeed essential, have a name for it. An earlier attempt at a arriage of these two sciences gave rise to the name hysical chemistry' for the range of study then ntemplated as a common range. This name, therwise suitable, cannot therefore well be used to escribe the very wide common field of the united emistry and physics of to-day. Physical chemistry as flourished in the meantime and acquired a gnificance of its own as the study of a limited mmon ground of chemistry and physics, covering ch subjects as the applications of thermodynamics d kinetic theory to the properties of gases, liquids d (particularly) solutions—no attempt has been ade to be exhaustive. Since physical chemistry pre-empted, and for want of a better, the author oposes the name 'chemical physics' for the widest ssible range of studies common to both chemistry d physics that it is possible to contemplate day.

Defined in this way, chemical physics really covers l theory of and experiments for the properties of atter, for which the atomic or molecular structure matter is relevant, both in equilibrium and nonuilibrium states. Such a study could only be fully vered in many large volumes. What is attempted re is less ambitious and far more useful. It is to esent the elements of chemical physics in a way at demands the minimum of mathematical technique om the reader, and, as the reader will frequently a chemist, in a way that is intelligible without uch previous study of theoretical physics. Thermonamics, statistical mechanics and kinetic theory rm, of course, a vital part of the subject, and are ven in Part 1 of the book. They are the essential k between the properties of atoms and molecules ven by the quantum theory and the properties of atter in bulk. They are presented throughout in form that has been chosen for reasons of simplicity d freedom from mathematical difficulties rather an logical beauty, and on this score little exception n be taken to the author's choice. For the nonathematically minded physicist, and above all emist, it will give an entirely admirable training this fundamental part of chemical physics, and r the mathematically somewhat more ambitious equally admirable introduction. It provides a urse of study suitable for a Part 2 Tripos student physics or in chemistry with any aptitude at all r formal mathematical theory.

Having covered the vital "Thermodynamic" ound in Part 1, Dr. Slater proceeds in Part 2 to ply the theoretical techniques just introduced to e various states of matter and phase equilibria. is part proceeds on well-established lines and is n excellent elementary account of this part of the bject, the needs of the same type of student being rne in mind throughout. The most interesting vel features of this part of the book—novel, that for such an elementary treatise—are the careful elementary discussion of melting and of the entropy difference between a liquid and a crystalline phase of a simple substance in Chapter 16; a discussion of phase equilibrium in binary systems covering the liquidus and solidus curves of a binary metallic alloy and the complete phase diagram for the mixtures copper–magnesium and copper–zinc, designed to whet the appetite of the budding metallurgist, in Chapter 17; and phase changes of the second order with special reference to order-disorder transitions in copper–zinc systems in Chapter 18—the whole expounded with elegant simplicity.

In Part 3, Dr. Slater passes on to the other main branch of the subject, atoms, molecules and the structure of crystals, in which thermodynamics plays a minor part, as most of the structures concerned are predominantly ordered at all temperatures, and the fundamental theoretical technique is that of the quantum theory. Thermodynamics survives in this part mainly in the theories of radiation (Chapter 19), thermionic emission and the Volta effect (Chapter 28) and the electron structure of metals (Chapter 29), where of course the photons and electrons still need statistical handling to give the properties of bulk matter. Here again the students' need for simplicity is carefully watched; *a priori* knowledge of the quantum theory beyond the barest outline is not essential to the reader. Results of the quantum theory are quoted and used mainly in a descriptive form, which the student of chemistry should be fully capable of following without study of their theoretical basis, unless he is interested to do so and willing and able to acquire the necessary mathematical technique. The outstanding feature of this part is provided by the three chapters (24–26) on homopolar bonds in inorganic molecules, organic molecules and the silicates respectively. Nothing but the simplest descriptive accounts of the simplest cases is of course attempted, in terms of shared electrons. The reader is told clearly where difficulty arises, as in the benzene ring. Nothing much more is possible without a here unwarrantable dive into the quantum theory of resonance. The bare statement, however, that the quantum theory accounts perfectly satisfactorily for these apparent difficulties of the shared electron picture might perhaps be backed up by suitable references, making an exception for once, in view of its importance, to the author's no-reference policy. The book would be improved thereby. Nor is the printing too happy in these chapters. The double dot notation of G. N. Lewis for the pair of shared electrons is admittedly very difficult to lay out for the printer for any but the simplest molecules. The reviewer would like to see even more of the structural formulæ not laid out in type, but drawn and reproduced from small blocks set in the text—an expensive method but amply justified by the added clarity it would give in this important part of this valuable text-book.

Teachers and students alike of elementary chemical physics, the wide field of theory which is rapidly unifying chemistry and physics into a single science (or at least into two close-knit branches of a single science), owe Dr. Slater a profound debt of gratitude for this book. It was a book that badly needed writing. The temptations along the author's path to indulge in too advanced ramifications have been nobly resisted. Only those who have planned and failed to write an elementary book in this field will appreciate fully the devastating difficulty of this success.

R. H. Fowler.

HISTORICAL PLANT GEOGRAPHY

An Introduction to Historical Plant Geography

By E. V. Wulff. Authorized translation by Elizabeth Brissenden. (A New Series of Plant Science Books, Vol. 10.) Pp. xvi+224. (Waltham, Mass.: Chronica Botanica Co.; London: Wm. Dawson and Sons, Ltd., 1943.) 4.75 dollars.

THE study of the areal distribution of plant species, genera, and families is what is generally understood in Great Britain by 'plant geography' or 'phytogeography', as distinct from the wider field of 'plant ecology'. It is in this sense that Prof. Wulff employs the term in the title of his book which, however, is expanded to "Historical Plant Geography" (without altering what we should regard as the proper content of a phytogeographic text) in order to convey the emphasis required by the author's outlook: "Historical plant geography has as its aim the study of the distribution of species of plants now existing and, on the basis of their present and past areas, the elucidation of the origin and history of development of floras, which, in turn, gives us a key to an understanding of the earth's history".

No branch of science could, more than this, need the fullest and most unreserved international co-operation, and it is a welcome sign that it should have been possible during war-time to get the work of a distinguished Russian botanist translated into English, and that this work should have been published through the activities of an enlightened Dutch *émigré* organizing botanical publications in the United States. British workers have in the past contributed much to the foundations of this subject, as can be shown by the mere mention of the names of Lyell, Forbes, J. D. Hooker, Darwin, Wallace, Willis, Ridley and Guppy. Nevertheless, it cannot be denied that in recent years it has lost much of its attractiveness as a subject of research to British botanists, probably in part because of a rather nebulous character consequent on its lack of exactitude and experimental techniques in comparison with other aspects of botanical investigation.

The subject, all the same, has moved steadily forward, and a considerable bulk of work done by Continental, and especially by Russian, phytogeographers is in this book made available to English-speaking botanists, while a very concise foreword by Hugh M. Raup makes a most helpful survey of the very significant American literature which has appeared on the subject in the last few years. The present volume is the first of three by Prof. Wulff and comprises a general and theoretical treatment of the principles of plant geography; the second, already written, is a "History of the Floras of the World", and the third, in preparation, deals with the changes in floras caused by man's activities. We hope that in due time all three volumes will appear in English, but meanwhile the first of them is most opportune. This is particularly so since the last few years have furnished to the phytogeographer such valuable new tools and so much fresh evidence, that a phase of expansion of the subject clearly lies ahead. Of this our botanical students are vaguely or not at all aware, and this first English text to reveal the new potentialities must therefore be valuable and welcome.

We can best convey the content of the book by the chapter headings: (1) historical plant geography: scope, relation to allied sciences, methods of investigation; (2) history of the science; (3) areas, their centres and boundaries; (4) the origin of areas (5) types of areas; (6) parallelism in the geographica distribution of plants and animals and correlatio between the distribution of parasites and that o their host-plants; (7) artificial factors in the geographical distribution of plants; (8) natural factor in the geographical distribution of plants; (9) th migrations of species and floras and their causes (10) historical causes for the present structure o areas and the composition of floras; (11) concep of floral elements.

Though impartially surveying the subject as whole, Dr. Wulff emphasizes throughout his ow attitude, that the primary object of the study i the revelation of the history and of the mechanism by which present areal distributions were achieved He stresses that we must bring to this study ever scrap of relevant evidence of fossil plants—"th importance of such data should not be unde estimated, since they constitute the only direc evidence available for establishing the history of flora". This attitude also involves the recognitio of the results of pollen analysis and other studie bearing directly upon the history of vegetationa migration and equally upon palæoclimatology. D Wulff assigns very great importance to large climati changes in altering the geographical range of plant He insists also that "Biogeographical conclusion only find definite confirmation, when it is possible t base them on a geological foundation. . . ." Th search for such foundations leads the author to co sideration of the alternative hypotheses of submerge continents, sunken land-bridges, and continent drift, as bases for explanation of present and pa plant distribution. He considers that the phytoge graphic data decisively support the latter type explanation despite the present inadequacy of th Wegener hypothesis for the Pacific region. It interesting to find that so experienced a phytoge grapher considers the influence of man to have bee relatively unimportant, and he agrees with Will in stressing the inability of introduced species spread into undisturbed natural communities. Indee it is suggested that both cultivated plants and the associated weeds have lost many of the adapti mechanisms needful for such expansion. Slowne of natural distribution is also emphasized: "Plan are dispersed as a result of the transport of the seeds by natural means only slowly and graduall gaining new territory step by step". There is n strong preference for one school of thought as again another, a broad objective width of approach chara terizing the whole book, the author, for exampl accepting and explaining relic distribution are with the same clarity and fairness that he gives the patterns formed by the expanding groups whe new species are being created.

Dr. Wulff rejects no type of evidence bearing the history of floras: study of the characters of th distribution areas themselves, critical taxonomic an morphological investigations of the group concerne the modern cytogenetical evidence, ecological adjus ment of the species, the effectiveness of dispers mechanisms, the nature and distribution of pla parasites and hosts, all are laid under contributio as is indeed logical and inevitable. That the resul are not always clear and beyond question is due the sparsity of available data. Dr. Wulff has show from how wide a field such evidence must com and on how wide a front advance in this subject now recommencing.

H. GODWIN.

The Royal Institution

By Thomas Martin. (Science in Britain Series: Published for the British Council.) Pp. iv+46+4 lates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1942.) 1*s*. net.

BEHIND its imposing Georgian front, the Royal Institution in Albemarle Street, London, coneals well-equipped laboratories fitted up for research in the physical sciences, a comprehensive library of general as well as scientific interest and a lecture theatre with all the aids that modern science has provided for the use of the lecturer. It was founded y Count Rumford, that remarkable genius who combined politics with philanthropy and both with science. Rumford, who was born in Massachusetts, New England, of a family of English descent, had held the post of under-secretary in the Colonial Office in London, and later had taken office under the Elector of Bavaria, in whose service he returned to London in 1798. He decided to remain in London, nd in 1799, with Rumford as the prime mover, the Royal Institution was constituted, "for diffusing the nowledge and facilitating the general introduction of useful mechanical inventions and improvements, nd for teaching by courses of philosophical lectures and experiments the application of science to the common purposes of life".

Mr. Thomas Martin has been general secretary of the Royal Institution since 1929 and knows its history intimately. In the present booklet he outlines the inception of the Institution and skilfully sketches the many scientific developments with which it has been associated through its distinguished line of professors and directors, from Rumford himself, through Davy, Faraday, Tyndall, Dewar and Sir William Bragg. Mr. Martin has accomplished the difficult task of compressing a story full of interest into a brief but fascinating booklet.

Diseases of Vegetables

By Donald E. Green. Pp. vii+208. (London: Macmillan and Co., Ltd., 1943.) 8*s*. 6*d*. net.

IN the monthly issues of the *Journal of the Royal Horticultural Society*, January 1941–April 1942, there appeared a series of excellent papers by Mr. Green ntitled "Hygiene in the War-time Vegetable Garden". These have now been brought together, revised and expanded to form the present book, which gives in brief but adequate form for market gardeners and amateur growers of vegetables information concerning the recognition and treatment of diseases of their crops, illustrated by a very rogues' gallery of excellent portraits of diseased plants.

Only one who has had much first-hand experience of diseased plants could write with so much practical insight as this book possesses, and only one knowing his growers intimately could have sensed and met their needs so well. Especially will all growers welcome he admirable "Key to Disease Symptoms" with which the book opens and the clear recommendations of practical measures of control with which it ends. The author is described on the title page as "Mycologist to the Royal Horticultural Society", but his book includes, in addition to the fungal diseases of vegetables, those caused by bacteria, viruses, and the various non-parasitic agencies such as unfavourable conditions of soil or cultural treatment.

The text is written in a simple but, at times, repetitive and wordy style with occasional sentences, statements, or omissions which might with advantage be reconsidered when a second edition is called for. For its price the book is most agreeably produced, and it should serve the needs not only of professional market gardeners but also of the multitude of amateur war-time growers who are apt to feel distressed and very helpless when faced with unexpected and strange lapses in behaviour on the part of their allotment vegetables.

Statistical Tables

For Biological, Agricultural and Medical Research. By Prof. Ronald A. Fisher and Dr. Frank Yates. Second edition, revised and enlarged. Pp. viii+98. (London and Edinburgh: Oliver and Boyd, 1943.) 13*s*. 6*d*. net.

THESE tables, first issued in 1938, were early recognized as an authoritative production in the domain of statistics as applied to biology. The main modern tests of significance, many the work of the authors, are covered; the introduction is a mine of knowledge in itself, and the tables cover all the contingencies envisaged.

This edition, which maintains the standard of the first even to the quality of paper used—no small achievement these days—incorporates new features. Additional tables are provided for precise testing of the significance of the difference between sample means when it is not valid to pool the estimates of variance. One essentially practical problem can thus be dealt with, namely, the comparison of estimates of a physical constant, one based on numerous data of low precision, the other on a small quantity of precise observations. An extra table provides the limits of expectation for the probability of an event observed to occur a number of times in a series of trials, and thus supplies a more direct solution than hitherto of another practical problem. The densities of organisms estimated by the dilution method can be easily calculated from a new table.

The complex subject of balanced incomplete block arrangements, used in field trials, involves the tabulation of combinatorial solutions, which have been simplified by the more extensive use of solutions of the cyclic type. A new type of square arrangement is described in the introduction.

The value of the volume is enhanced by the worked examples illustrating the use of the tables.

J. WISHART.

Practical Physics

By Prof. Marsh W. White, Dr. Kenneth V. Manning, Prof. Robert L. Weber, Dr. R. Orin Cornett, and others on the Physics Extension Staff. (Pennsylvania State College Industrial Series.) (Prepared under the direction of the Division of Arts and Science Extension, the Pennsylvania State College.) Pp. x+365. (New York and London: McGraw-Hill Book Co., Inc., 1943.) 2.50 dollars.

THIS course of study, which is stated to have been tried out on a large scale in Pennsylvania during the War, resembles both in scope and quality some of those devised for evening classes in physics that are customary in Britain for engineers attending National Certificate courses. The emphasis is on mechanics, heat, and current electricity; less attention is given to sound and light. Each chapter reads like the record of a lecture, enlivened by popular illustrations and numerical examples, and followed by a simple experiment, performed either by the lecturer or by a group of students. Unlike several British books having similar titles, this is not a guide to precise experimental technique. The word "practical" in the title may perhaps be justified by saying that the lectures were designed to suit "practical men" in the sense of people of *I.Q.* about 120, who are familiar with tools, who have scant time for study, and who may be tired after a day's toil. Theory, such as occurs in first-year university courses, is here cut out as much as possible: there remains a little algebra and trigonometry, but no calculus. For example, a chapter on uniform circular motion begins with pictures of machines, states the formula for centripetal force without proof, and explains carefully its general interpretation and briefly its applications to aviation, to cream separators and to banked roadways. The chapter then offers a set of numerical examples, and ends with an experiment in which a girl student is shown holding a vertical glass tube through which passes a string, attached below to a weight, and above to a mass which she whirls in a horizontal circle. A blank form is provided for the observations and deductions.

Protest must be made against the reappearance (on p. 56) of the old fallacy that the time taken for a rise of temperature to move along a metal bar depends only on its conductance; whereas, in fact, its specific heat and density are just as essential.

Honours graduates in physics, who are about to begin to lecture in National Certificate courses, would find in this book a guide to what is possible in those circumstances. L. F. RICHARDSON.

Recent Advances in Galactic Dynamics

By Prof. A. C. Banerji. (Lucknow University Studies, No. 15.) Pp. vi+116. (Lucknow: Lucknow University, 1942.)

THE author of this book was invited to give three extension lectures at the University of Lucknow in 1940 on galactic dynamics, and they have now been published in the form of a monograph. The first lecture deals with polytropic configurations of rotating gaseous matter, and provides an excellent summary of the work of investigators from the earliest times up to the present. It ends with a brief discussion of the numerical solution of the differential equations which occur in the cases of polytropic configurations of rotating gases. The second lecture summarizes the investigations of Hubble, Jeans, Brown, Vogt and Lambrecht, Lindblad, and a number of Indian workers, including the author, on spiral nebulæ. A full account of the researches of Indian workers has appeared (*Phil. Mag.*, 7, 28, 118; 1939), and also in a number of Indian publications of more recent date. The origin of the solar system is considered in the third lecture, and the various theories to explain it are dealt with, from Swedenborg and Kant's nebular hypothesis to the recent theory of Lyttleton that the sun was a binary, its companion being disrupted by a passing star, the planets and satellites being formed from the debris. The investigations of Bhatnagar are considered and these have an important bearing on certain problems connected with planetary formation. He has shown that there is no possibility of the formation of the ribbon, from which the planets were supposed to be formed, by a close encounter or even a grazing collision between stars of normal masses. In addition, he has shown that the origin of the solar system is inexplicable by any existing tidal theory.

This is an excellent summary of our knowledge o stellar dynamics, and its value is enhanced by th references to all the workers on this subject.

M. D.

Intermediate Qualitative Analysis (Inorganic)

By Dr. A. J. E. Welch. Pp. iv+154. (London University Tutorial Press, Ltd., 1943.) 3s. 9d.

THIS book provides theoretical and practic instructions for the qualitative analysis of mi tures, and can be recommended for the use of student at the Intermediate and Higher Certificate stage.

An outline of the theoretical principles underlyin qualitative analysis is given first of all, and, apa from the use of the obsolete ferric-thiocyanat equation for the illustration of the law of ma action, it is quite adequate. There then follows a excellent chapter on the preliminary tests, apparatu and experimental technique of analysis. Especiall clear instructions are given on the use of the blowpipe, platinum wire, etc., in the dry tests which a so frequently bungled by inexperienced students.

The reactions for the identification of metall radicals are described in sufficient detail, but it is great pity that they have been represented throug out by molecular equations and the opportunit thereby lost of emphasizing the ionic character most of them. The tests for acid radicals have bee arranged in a system of three groups which shou be easy to operate.

In the closing chapter the tests are summarized i a tabular form which should prove useful, especial as the correct quantities of the reagents have bee specified. A. C. C.

A New German-English Psycho-Analytical Vocabulary

By Alix Strachey. (Research Supplements to th International Journal of Psycho-Analysis, No. 1 Published for the Institute of Psycho-Analysis.) P v+84. (London: Baillière, Tindall and Cox, 1943 10s. 6d. net.

DICTIONARIES are of use to many and a sourc of real joy to a few. To this small minority th present slim volume will prove additionally attracti through its excellent typography. It is, as the prefac states, essentially an enlarged and revised edition a glossary issued as a supplement to the *Internation Journal of Psycho-analysis* in 1924. It does no contain the interesting notes and comments appende to certain entries in the former work, but with th increasing standardization of psycho-analytic terminology in the intervening years these are no scarcely necessary. A good many terms that we being tentatively introduced at the earlier date hav now been generally adopted; for example, ‘para praxis’ and ‘cathexis’ (for *Fehlleistung* and *Besetzun* respectively). On the other hand, the word ‘u pleasure’ (for *Unlust*), formerly described as “hardl acceptable linguistically”, is now accorded th dignity of a technical term. Those who grumble a the ‘Freudian jargon’ will probably express ‘di pleasure’ at such terms as ‘scopophilia’ and ‘osphr siophilia’, but would they stomach ‘peeping’ an ‘sniffing’ any better? It is perhaps a pity tha Havelock Ellis’s more euphonious ‘eonism’ (o analogy with ‘sadism’ and ‘masochism’) is not give as an alternative to ‘transvestitism’.

J. C. FLUGEL.

A HUNDRED YEARS OF ANTHROPOLOGY IN BRITAIN

By SIR JOHN MYRES, O.B.E., F.B.A.

THOUGH the Royal Anthropological Institute was not founded until 1871, it is the direct successor of the Ethnological Society of 1843, after amalgamation with the Anthropological Society of 1863, and may justly claim now to celebrate, on October 30, the centenary of the organized study of man in Great Britain; and the main turning-points in the careers of these Societies illustrate the general course of events in a wide range of studies, from comparative anatomy of the principal human varieties to comparative religion, sociology and linguistics, and the whole range of the material arts with their archæological perspective, so nearly co-extensive with human palæontology.

At first sight this study of man is no systematic science, like chemistry or physiology, but rather analogous to geology and geography, which combine the methods and the data of more specific branches of knowledge for the elucidation of problems of a secondary order, and especially involving relations of distribution in time and space. But it has been characteristic of British anthropology to insist that the peculiar nature of man provides the same kind of common basis and definition for a coherent mass of information, and systematic study of this material by every available means, as the earth provides in geography—and not least because in geography, too, it is 'the earth as the abode of man' which seems to many geographers to differentiate between this study and geology or terrestrial astronomy. American anthropology has followed the same line of thought and development; partly because in the New World, as in the British Empire, there has been so great a wealth of opportunity for the regional study of more or less self-contained and self-determined varieties of mankind, so that analytical studies of structure, language, material and social equipment have been continually challenged and tested by fresh discoveries in the field; whereas in most European countries, less well provided with 'aborigines', the special sciences which contribute to the study of man have developed independently, and lost this common basis of humanity. It is also this common objective, which has given to much British and American work a disciplinary and educational value, and thus has at long last determined the position and function of the principal anthropological institutions and schools, as the outline of an academic discipline which might claim in due time to be *Literae humanissimae*.

Though both physical anthropology and the elements of ethnology, and what is sometimes distinguished as cultural anthropology, had long been studied discursively, in classical culture, and from the Revival of Learning, there were many convergent instigations to more systematic treatment in the early years of the nineteenth century. The Romantic Movement, and the Revolutionary Movement which emerged from it, gave the same impulse to human studies as to the physical sciences. In both the cry was 'back to Nature', at whatever cost to convention or authority. Anatomical studies reformulated old problems of the origin and significance of human races and varieties. Comparative philology indicated processes of modification and replacement among languages, and relations of heredity between them, seductively like those of a pedigree, and sometimes correlated regionally with major racial types, Semitic with Arab, and the like. The Danish archæologists combined typological classification of implements—stone, bronze, and iron—with the stratigraphy of the peat bogs where they were found, and especially with secular changes of flora and climate. Cave-finds in France and in England associated rude implements with 'ante-diluvial' fauna, and even with human remains. Comparative mythology, in dangerous alliance with philology, led on to the interpretation of social and political terms in kindred languages, to a comparative sociology, and to a 'linguistic palæontology'. The common factor in all these new studies was the notion of development and series of events in time.

There were other considerations, more practical and controversial; the abolition of slavery was a corollary of the Rights of Man within one human species. But what if, zoologically, there was more than one human species, of separate special creation and independent 'place in Nature', like that of the domesticable animals, over whom human dominance seemed to have biblical sanction. Was not *black* man, in fact, the 'natural slave' as defined in Greek philosophy? To some, the American Indian seemed to present a similar problem, as the economic expansion of the West went on. On both sides zoological arguments were brought in, to support philanthropy or to challenge vested interests, and it was long before this kind of 'applied anthropology' became obsolete.

There was also the practical question: What was to be done with the 'black brother' after emancipation? Was he improvable into something not so far from white? What was the relation between physical and mental characters in man, and what could be done to perfect Nature's work by scientific processes? It is significant that most of the early British anthropologists were practising medical men, and James Cowley Prichard, the most eminent, was a Commissioner in Lunacy, with a high repute in questions of the moral and legal responsibility of the insane. Several were also members of the Society of Friends, and Thomas Hodgkin was the founder of the Aborigines' Protection Society in 1838. Other philanthropic agencies, the Negro Emancipation Society and the British Africa Colonization Society (both of 1834), collected information and used it as best they could. Another foster-parent, for obvious reasons, was the British Phrenological Society.

The earlier history of the Ethnological Society has been so fully told elsewhere that only essentials are necessary here. It was never a populous or influential body, and owed its existence and successes to a small group of original and devoted men, nearly all in professional careers, and very few of them affluent. On many occasions the same persons appear as the active members of the geographical or zoological section of the British Association, sometimes in a specific subsection for ethnology; and this summer and winter partnership, never quite effected in any other section, makes the origin of some enterprises difficult to trace, except personally.

In 1839 Prichard addressed to the British Association a warning, already needful, on "The Extinction of some Varieties of the Human Race", and appealed for prompt and organized effort to record this vanishing material. It was the first of a long series of such appeals, to forestall both the disappearance of aboriginal communities altogether, and the no less fatal effects on aboriginal customs, of contact with colonists, traders, and missionaries. For the guidance of intending travellers and of observers already in contact with natives, the British Association appointed a committee to draft a pamphlet of "Instructions to Travellers", in which the whole programme of anthropological and ethnological research was set forth: an original and stimulating directory, and the immediate predecessor of the well-known "Notes and Queries in Anthropology" which have for many years been printed and reprinted by the British Association, but sold, and distributed to travellers, by the Anthropological Institute. It was the first example of a type of handbook of which the most famous is the Royal Geographical Society's "Hints to Travellers".

On June 22, 1842, Prichard again addressed the British Association "On the Relation of Ethnology to other Branches of Knowledge", with the outline of an inclusive programme of advanced study and objectives for research; and on July 20 the prospectus was issued for an Ethnological Society, signed by Richard King (1811–76), a pupil of Thomas Hodgkin at Guy's (M.R.C.S. 1832 and hon. M.D. of New York), who had been surgeon-naturalist to Capt. George Back's expedition to the Great Fish River (1833–35), and published a book on the Eskimo in 1844. The first meeting was held early in November, 1843, with King as secretary and Admiral Sir Charles Malcolm (1782–1851) as president. Malcolm had been superintendent of the Bombay Marine, the precursor of the Indian Navy; he had created a distinguished school of surveyors, and devoted much of his leisure to the Royal Geographical Society and to the organization of charities. Meetings were held in Hodgkin's house in Bedford Square, London, and in hired rooms at 27 Sackville Street, W., and both Hodgkin and Prichard seem to have been generous financially. The latter published his "Natural History of Man" in 1843, and died in office as president in 1848. Another good friend was James Crawfurd (1783–1868), who had used the opportunities of a medical career in India and Malaya and returned home in 1827 to devote himself to Oriental languages.

King returned to arctic exploration in 1850, wrote an inclusive account of the long search for Franklin (1855), published an account of the Lapps (1871), and lived to be a member of the first council of the Anthropological Institute.

Another pioneer, on rather different lines, was Robert Knox (1791–1862), who graduated in medicine at Edinburgh in 1814, served as army surgeon at Waterloo, studied in Paris under Cuvier (1769–1832) and Geoffroy E. Saint-Hilaire, and organized the Museum of the Royal College of Surgeons at Edinburgh (1825), collecting material under the adventurous conditions of the time. Passionate and heterodox, he gravely damaged his own prospects; he lectured volubly on the "Races of Man" in many places, and wrote copiously in the Press, rendering much erratic help to the Society, and became in 1860 an honorary fellow and honorary curator of its museum. He held strong polygenist views but deemed the origin of races to be beyond human inquiry. His influence, therefore, waned when Darwinian evolution was popularized.

Very different are two anthropological pioneers of the next decade. John Beddoe (1826–1911), of Bridgnorth, graduated in medicine from University College, London (1851), and studied in Vienna. Hospital service at Renkioi in the Crimean War extended his earlier studies of hair and eye colour (1846) to Mediterranean peoples, which he continued to observe in Bristol and Cardiff when he went into general practice. His massive material on "Stature and Bulk of Man in Great Britain and Ireland" (1870) and "The Races of Britain" (1885) has been supplemented but not replaced, especially by the British Association's Ethnological Survey Committee and Anthropometric Committee. He was an early and active fellow of the Ethnological Society and a foundation member of the Anthropological Society, and it was under his presidency of the latter (1869–71) that the schism was reconciled and the Anthropological Institute inaugurated.

George Rolleston (1829–81), combining classical scholarship with anatomical distinction, served, like Beddoe in the Crimean War, and as Linacre professor of zoology at Oxford amassed a valuable collection of crania, submitted his system of brain-classification to the British Association at Oxford (1860) and supported Huxley in opposition to Owen at Cambridge in 1862. His Royal Institution lecture (June 24, 1862) is another turning point. With William Greenwell ("British Barrows", 1877), he established the racial history of Britain on the same sure foundations as the racial distributions outlined statistically by Beddoe.

But the leading mind in ethnology during the Darwinian period was that of Thomas Henry Huxley (1825–95), whose learning, judgment, and skilled advocacy made him a second founder of the science in Britain, and moreover the leading spirit in an 'evolutionary' movement far outranging his own anatomical and zoological contributions. The notion of natural selection and survival of the fittest was applied to arts and crafts by General Pitt Rivers to archæology by John Evans and Augustus Franks to institutions by John Lubbock, above all in traditions, ideas and beliefs by Edward Tylor, whose establishment at Oxford (1883), through Rolleston's influence, was the first academic recognition of the new study of man.

The practical issue of American slavery revived old controversies and gave scope to the enthusiasms of James Hunt (1832–69), who joined the Ethnological Society in 1856 and was its secretary during 1859–62. Fresh light on the origin of man came from the palæolithic discoveries of Boucher de Perthes, verified by Prestwich and John Evans in 1859; the Neanderthal skull had been found in 1857, and the cave of Aurignac was opened in 1860. But Hunt's enthusiasm failed to rouse the Ethnological Society, and in 1863 he founded the Anthropological, edited the *Anthropological Review*, and published translations of Waitz and Gerland, the leading ethnologists in Germany, and of Gastaldi on Swiss and Italian lake dwellings. The Anthropological Society loved discussions and ranged far afield, to woman's rights, the Irish question, and above all the Negro question. Its first chairman was Sir Richard Burton. Hunt defended slavery, on the old zoological ground of a plurality of species, at the British Association in 1863, where with Huxley's support a subsection was established for anthropology in 1866 under Section D (Zoology). But Hunt was combative and difficult; he resigned the presidency of his Society in 1867, but remained its 'director' until his premature death in 1869.

The way was now open for reconciliation. The Negro question had been settled by the American Civil War; Huxley in the chair of the Anthropological Society, and Beddoe of the Ethnological, rallied men of goodwill on all sides, and in 1871 was established the Anthropological Institute of Great Britain and Ireland with Sir John Lubbock as its first president. With the financial help of the British Association, the revised "Notes and Queries in Anthropology" were published; the Anthropometric Committee of 1875 gave much needed definition to physical anthropology; and its annual measurements of the members of the British Association did much to popularize statistical treatment of its problems. Organized by Francis Galton, this was the precursor of the Galton Laboratory at University College, London, and of the systematic study of biometry and eugenics in Britain.

When the original library and museum, at 4 St. Martin's Place, W.C.2, were pulled down, the good offices of the president of 1883–85, William Henry Flower, secured an appropriate home in the upper part of the Zoological Society's house at 3 Hanover Square. This arrangement, however, was nearly disastrous to both institutions, for the weight of exhibits from the first excavation of Stonehenge (1901–2) irretrievably damaged the building and hastened the transfer of the Zoological Society's offices to Regent's Park. By this time the close association of the Institute with the ethnological staff of the British Museum, inaugurated by Augustus Franks and extended by Charles Hercules Read and others down to the present time, drew the Institute into a succession of abodes in Bloomsbury, the last of which, 21 Bedford Square, is within a few yards of the original meeting room in the house of Thomas Hodgkin.

Of the mature work of the Institute only outlines are possible here. Like its predecessors, it has never been rich, and has owed much to benefactions supplementary to its normal income; from the Carnegie Trustees for the improvement of its valuable library, from the Rockefeller and Laura Spelman Rockefeller Foundations to maintain its *Journal*, and from other friends for a few small expeditions. But it has never had the popular appeal of the Zoological or the Royal Geographical Society, or the support of academic or industrial interests. Side by side with its proper business of the promotion and publication of research, it has never ceased to urge on the Colonial Office and other public agencies the pressing need for expert acquaintance with the customs and mode of life of the native peoples of the British Empire; but until recently with disappointing response, in comparison with stately institutions such as the Colonial Institutes of the Netherlands and of Belgium, and the Bureau of Ethnology in Washington. Even the urgent task of recording institutions and modes of life which have been fading away before our eyes has been postponed irretrievably. The inevitable dissipation of energies in specialist societies has been minimized by the establishment of research committees within the Institute itself, for India, Africa, Anthropometric Standards, and the like, and of a Joint Committee for Anthropological Research and Teaching, on which universities and independent institutions are entitled to be represented, which has no parallel in other branches of learning in Great Britain. In the generation following the war years 1914–18, as the spokesman of that Joint Committee, the Anthropological Institute has twice taken decisive part in the organization of the International Congresses for Prehistoric and Protohistoric Sciences (London 1932, Oslo 1936) and for Anthropological and Ethnological Sciences London 1934, Copenhagen 1938), which have provided at least the constitutional foundations for worldwide co-operation on liberal lines in time to come.

ACTIONS OF DRUGS

ABOUT two hundred and fifty persons attended a discussion in London on September 24 organized by the Faraday Society and entitled "Modes of Drug Action". The meeting lasted six hours and a wide ground was covered by the papers, which had been circulated in proof. These papers contained much interesting matter and it was perhaps unfortunate that too large a proportion of the available time and energy of the meeting was devoted to listening while they were expounded. In the following account the order in which the papers were given has been altered.

Prof. E. K. Rideal, who took the chair, paid a tribute to Sir William Hardy, who was responsible for initiating these joint discussions between biologists and physical chemists. Sir Henry Dale, in his general introduction, stressed the complexity of the problems of pharmacology and warned the meeting against the optimistic adoption of simple theories to explain complicated facts. Most of the generalizations that have been made have exceptions, and it is on these that attention should be focused.

Prof. J. H. Gaddum discussed the antagonism of drugs, and the quantitative relations between the antagonists. It is important to distinguish two kinds of interaction, both of which may give rise to graded antagonism over a wide range of concentrations. Some antidotes neutralize poisons by forming inert compounds with them, as SH- compounds do with mercury. In this case the study of the antidote throws no light on the action of the drug on the tissue. Its action is merely to reduce the concentration of free poison present.

Other antidotes act by competing with poisons for chemical groups essential to living tissues. The study of these is more interesting, since it allows drugs to be classified according to their antagonists, and may provide evidence about the particular chemical processes in the cell with which the drugs interfere. The work of Woods on the antagonism of sulphanilamide and *para*-aminobenzoic acid is a striking example of work in this field. The quantitative relationships between antagonists were discussed. If the reactions are of the first order, the ratio of the concentrations of the two drugs which together produce a given effect should be constant, provided that the concentrations of one drug are calculated as differences from the threshold concentration. This is true whether the drugs neutralize one another or compete, so that it is impossible to distinguish the two kinds of antagonism except from independent evidence that the drugs either combine with one another or have molecules which would be likely to combine with similar groups in the tissues.

Dr. H. R. Ing discussed the theory that drugs combine with specific receptors in tissues and the extent to which it can be used to interpret the relation between chemical constitution and pharmacological action. When a series of allied drugs is studied, it is often possible to recognize pharmacodynamic groups which appear to be essential for one particular type of action. It might be said that this group is essential for combination with the receptors, but there are anomalies. The same pharmacodynamic group is commonly present both in active drugs and in their antagonists. The results can be explained in terms of competition between the two drugs for the receptors, if it is assumed that one of them causes an active response and the other blocks the receptors but causes no response. Since drugs with a feeble action do not antagonize drugs with a greater action on the same receptors, the response must depend only on the amount of drug combined with the receptor and not on the magnitude of its effect when so combined, which must be all or none. The receptor theory provides a useful intellectual framework for the consideration of the qualitative aspects of the problems presented by the structure and action of drugs. We do not know enough of the receptors to predict the effects of minor changes in the molecule.

The relations between *in vivo* and *in vitro* actions of chemotherapeutic agents were discussed by Dr. H. McIlwain. He gave an able summary of the extensions of the theories of Fildes and Woods which have enabled him to discover new types of therapeutic agent by using substances similar in chemical structure to the normal metabolites of bacteria. The results obtained in the body are complicated by variations in the concentrations of antagonistic substances, and by the actions of the body on the drug and the drug on the body. These interactions are not always the same in different species of animal and under different conditions, and a complete picture can only be attained by correlating observations on whole animals with those obtained *in vitro*.

Sir Rickard Christophers gave an account of work on the metabolism of the malaria parasite, which consumes oxygen at a high rate ($Q_{O_2}=35$) and utilizes glucose if it is present, but can utilize various other foodstuffs in the absence of glucose. Drugs which are used in the treatment of malaria inhibit the oxygen consumption when they are present in concentrations such as may occur in the blood in treatment. This work provides an opportunity for studying the action of these drugs *in vitro*, and so measuring the activity of drugs, without having to consider the complicating effects of differences in their rates of absorption and excretion.

Dr. E. M. Lourie discussed the failure of some arsenical drugs to penetrate the blood-brain barrier and so to act on trypanosomes in the brain in the late stages of sleeping sickness. The best method of studying this problem is probably the estimation of the trypanocidal power of the cerebrospinal fluid when the drugs are administered; but even then, drugs may reach the fluid through the choroid plexus without ever coming in contact with the brain cells. There is some evidence that acid compounds penetrate the barrier more readily than basic or neutral compounds.

The relation between the chemical structure of organic arsenicals and their combination with trypanosomes was dealt with by Dr. H. King. He divided these drugs into three classes; some, like phenylarsenoxide, are active because their properties make them concentrate at lipoid interfaces; some, like atoxyl, show large differences in their actions on normal strains and drug-resistant strains of trypanosomes, and these probably combine with the organism in the same way as acridine dyes; others, like phenyl glycine arsenoxide, are probably not concentrated in the organisms at all. These factors control the combination between drug and organism. The subsequent action of the drug probably depends on quite other factors, such as a combination with SH- groups.

Dr. J. H. Quastel discussed the action of narcotics, and of amphetamine, on the central nervous system. Narcotics reversibly inhibit the oxygen uptake of minced brain, or of brain slices, in concentrations similar to those occurring during anæsthesia in the whole animal. The effect is most marked when the substrate is glucose, and is almost absent when the substrate is succinate. They also specifically inhibit glycolysis in other tissues; but there is evidence that the brain is particularly dependent on glucose metabolism, and that may be why the brain is particularly susceptible to narcosis. Tyramine, and some other amines, cause a diminution of the respiration of brain, which increases with time and is due to an aldehyde formed from tyramine by amine oxidase. It is suggested that the wakening effect of amphetamine, and other amines which inhibit amine oxidase, is due to inhibition of the formation of aldehydes, which are normally present and which normally cause a partial depression of the central nervous system.

Prof. F. Weigert described experiments on the fate of benzpyrene in the body. The long latent period in the carcinogenic action of this substance raises the question whether it persists throughout this time as such, or is changed into some other carcinogenic substance. The substance itself and some of its products in the body can be detected by their fluorescence and purified by chromatography. One of these products is particularly liable to collect in the tissues where cancer is liable to occur, and may be the immediate cause of the cancer.

Prof. E. K. Rideal discussed the general question of the combination of drugs with tissues in terms o electron chemistry. The forces involved are complex and can profitably be studied by measuring the energy of adsorption of drugs on proteins, by the chromatographic method and by putting drugs in solution beneath monolayers in a trough. The application of these methods to pharmacologica problems is still in an embryonic stage, but holds the promise of explaining the behaviour of drugs in terms of the detailed constitution of their molecules.

Dr. J. H. Schulman emphasized these views by giving actual examples. It has, for example, been shown that the lytic activity of a series of surface active long-chain paraffin ionic salts bears relation only to their surface activity at a cholesterol o protein interface, and in no way to their effect on the surface tension at an air-water interface. The optimum activity of synthetic oestrogens is correlated with their adsorption at a protein interface. Th adsorption of proteins causes precipitation of lipoid emulsions provided that the charge on the protein i the opposite of that on the emulsion. The effects o using emulsions with different charges, and different proteins at different hydrogen ion concentrations can be successfully predicted from this theory.

Dr. H. Hurst spoke at some length of the actions of drugs on insects, and emphasized the fact tha when the drug is applied to the outside of the insec its action is very much influenced by the permeabilit of the cuticle. His views on this subject have recentl been published in NATURE (**152**, 292; 1943).

Three papers from the Physical Chemistry Labora tory at Oxford described studies of the growth o *B. lactis aerogenes* in artificial culture. There i normally a lag-phase followed by a phase of exponential growth, and the growth then slows u again and the population eventually becomes con stant. Dr. R. M. Lodge and Prof. C. N. Hinshelwoo described the adaptation of the organism when it i transferred from bouillon to a simpler syntheti medium. In the first few subcultures growth is slow and abnormally long, snake-like cells are formed. I is concluded that separate mechanisms, responsible for (*a*) the removal of growth inhibitors, (*b*) elongation and (*c*) division, become adapted at different rates to the new medium.

Dr. G. H. Spray and Dr. R. M. Lodge described the effects of resorcinol and *m*-cresol, which cause a prolongation of the lag rather than a slowed rate of growth, or a diminution of the stationary population. Resorcinol is eventually completely inactivated by the bacteria, but *m*-cresol is not. Long, snake-like bacteria can be produced by *m*-cresol under certain conditions. Dr. D. S. Davies and Prof. C. N. Hinshelwood described the effects of sulphonamides, which both increase the lag and reduce the growth-rate, but do not inhibit growth completely even in high concentrations. On subculture in the presence of sulphonamides the organisms become immune to the drug. Thus immunity is at first partial, reversible and specific to the particular sulphonamide (sulphanilamide or sulphaguanidine) used. After thirty subcultures it becomes complete, irreversible and unspecific. The theory that this is due to the selection of resistant organisms is rejected, and it is assumed that the cells develop enzymes which produce a sulphonamide antagonist. The partial antagonism which develops earlier is probably due to other causes.

A full account of the meeting will appear in the *Transactions of the Faraday Society*.

J. H. GADDUM.

AREA HEATING

THE publication of recent technical papers* on so-called district heating emphasizes a grave omission in the County of London Plan; indeed, the term is mentioned a few times, but there is no consideration of the very great contribution this development of applied science can make, on several grounds, to the social development of large population groups which have arisen in Great Britain, especially the conurbation of London. The subject is very briefly mentioned in the exhibition of planning now open at the Institution of Civil Engineers, held jointly by that body and the Institution of Municipal and County Engineers. Twice in the last twenty years St. Marylebone Borough Council, which generates its own power, discussed supplying the local housing estates with heat, but failed to grasp the opportunity of obtaining experience in this field.

There is a ray of hope, however; Coventry has just agreed to incorporate district heating in its reconstruction programme. The local authority still has to convince the Electricity Commissioners, and then bring a Bill before Parliament. Further, the Public Works Committee of Bristol has had submitted to it a plan to cover the central area of that city.

The major public difficulty is that the existence of district heating is not obvious. It is not like a railway, bridge, or power-transmission line, which anyone can observe or appreciate for use or value. District heating is not known in Great Britain, whereas it is a national policy in the U.S.S.R.; Russian schemes already dispose of more heat than is conveyed by all the town-gas in Britain. Hamburg has had it on an increasing scale for half a generation, and each of the latest German schemes is larger than the New York plant, which uses 775,000 tons of coal annually.

What, then, are the virtues of district heating? Practically all electric power in Great Britain is generated by high-pressure and high-temperature steam, dropping its entropy in turbo-generators. The maximum working efficiency of energy conversion from coal to electricity is not likely to exceed 30 per cent in the most modern, and consequently all new, power stations; it averages 20–25 per cent. The major loss is in the condensation of the steam at low-pressure, necessary for the operation of steam turbines; that is, the latent heat is wasted. In other words, every large power station is throwing away a million kilowatts continuously into the local river or its cooling towers.

The usage of electric energy is increasing at a rapid rate, and in many large places, which provide centres of gravity of electric loading, new power stations will be required. London after the War will, it is probable, require several new power stations or great extensions to cope with the increasing load. The more electric energy is used under the present system, the more coal energy is wasted. The natural and obvious proposal is to utilize this wastage of heat for domestic and process work in the neighbourhood of these power units.

Continental practice shows that a distribution of this waste heat is easily economical up to seven miles, and, in favourable circumstances, several times this. It is calculated that with reasonable capital expenditure, which can be amortized in between five and fifteen years, depending upon the particular circumstances, such heat can be sold at not more than 4*d*. per therm; this would make important contributions to coal conservation.

A more attractive scheme is to burn the coal in boiler stations, in which can be realized efficiencies of conversion up to 90 per cent, on the rim of large centres of population, transmit the steam through large pipes to turbo-generators located at the centre of gravity of the electric load, and dispose of the heat, which otherwise would be wasted, in the surrounding domestic and industrial areas. The wastage of heat in such pipe transmission is of the order of 1 per cent for seven miles, because of the very large diameter required; the pipe need not be lagged with heat-conserving material. In one step we save the expensive area required for a coal depot essential now to every power station, the consequent dirt which arises from coal and ash handling, and any more which is permitted by expensive smoke cleaning plant to escape through unsightly chimneys; we have saved not only the cost of expensive condensing plant, and cooling towers on non-river sites, but also, in the latter case, expensive ground and the enormous amount of condensation which is inevitable in their region during humid weather. The problem of noise arising from generators in a comparatively small building can easily be coped with by modern methods of noise control.

Having decided to dispose of hitherto wasted heat—and it may be remarked that it is not possible to extract much heat from existing power stations because the full benefits are not realizable without special designs of back-pressure turbines—the problem is to distribute such heat in the form of hot water or steam at high pressure to the situations where it can be utilized. Naturally, the regulation of demand, which would not be exactly in step with the electric power demand, causes some difficulty, but this can be overcome by having adjustable back-pressure on the turbines with suitable heat-reservoirs, these taking the form of lightly heat-insulated steel water-towers; the pipe-lines would be tapped to convert the heat through thermostatically controlled calorifiers in consumers' premises. The County of London Plan, with its new roads, both radial and ring, offers not only suitable routes for the large piping which would be required for the main heat transmission routes, but also, since these routes go through areas which are intended for planning on the ten-story-block-of-flats principle, the latter could be designed immediately for district heating with a minimum of capital expenditure, thus saving valuable boiler accommodation and fuel storage.

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* *Electrical Times*, Sept. 30 and Oct. 14, 1943; *Engineering*, Oct. 8, 1943; *Industrial Heating Engineer*, July–Oct. 1940.

With regard to competitive forms of heating, the Engineers' Study Group on Economics, collecting information from many organizations, had previously deduced that it is in the national interest to use gas rather than electric power for basic domestic heating, the point being that if large sections of the population could be persuaded to abstain from wastefully using soft coal in domestic hearths and to use coke or other low-temperature carbonized coals instead, it will be necessary, in order to provide such hard fuel at reasonable cost, economically to get rid of great quantities of the minimum gas which is necessarily involved in producing any specified quantity of hard fuel. Prof. C. L. Fortescue, in an informal discussion at the Institution of Electrical Engineers, also arrived at the desirability of increased domestic heating by gas from other arguments. Thus there is competition on technical, social, and economic grounds between district heating by waste-heat from power stations, and domestic heating by means of gas. Electric power is so precious and high-grade that it must be considered out of the question for basic domestic heating, except in special circumstances.

A further reason for the usage of gas for basic domestic heating is the technical one of regulation. It is well known that in suburban areas in which domestic gas-cooking is prevalent, the drop in pressure at the peak-loading, especially for Sunday dinners, is serious. It is therefore desirable to use electric power for cooking, because of its high regulation, which is also essential for lighting and normal power requirements. We are thus led to conclude that electric power should be reserved for those applications where good regulation is desirable, and gas should be used where, through automatic control, such as in gas central heaters, which have been hitherto little used in Great Britain, close regulation is not essential.

What case, therefore, can be made for district heating? It must be based on the fact that electric power is increasingly demanded, and therefore there is a waste of energy, as explained previously. It follows, therefore, that in the national interest district heating should be used where practicable and economic, the gaps being filled by gas. Electric power should be reserved for those applications where it is most effective, such as electric traction, electric lighting, and the manifold large and small power uses where its delicacy of control gives it an advantage over any other competing form of power.

On social grounds, district heating would, at one stroke, if carried out on a large scale in large centres of population, dispose of the necessity of the traditional domestic fire and the consequent wastage of heat into the open sky, the pollution of the atmosphere with unconsumed carbon, and the wide-scale deterioration of buildings because of the sulphur acids emitted into the atmosphere. The point here is that whereas in large power stations the exhaust gases can be cleaned efficiently, or so dispersed in countryside areas that their effect on man and Nature is substantially zero, there can be no such control over the tiny combustions which occur, to the number of millions, in domestic premises. The general adoption of central heating which has taken place in other countries may not be desirable in Great Britain; in fact, the ideal for our more moderate but erratic climate would be semi-central heating, topped up with a small amount of radiation, gas or electric. In this way the great value of our climate—its variability between extremes which are small in comparison with climates in other parts of the world—is conserved, both indoors and without.

L. E. C. HUGHES.

OBITUARIES

Mr. A. C. Gardiner

ALAN GARDINER died on August 29 at the age of forty-six. The news came as a great shock to his many friends, and hydrobiology suffered a severe loss He was educated at Oundle and Gonville and Caius College, Cambridge, and inherited a love of science from his brilliant father, the late Dr. Walter Gardiner. As soon as he had graduated in 1920 he began the line of research which always continued to attract him: the problems of plankton ecology, sometimes freshwater, sometimes marine, and refinements in the methods of attack. This work, although broken by periods of illness, was always taken up again, and he was actively pursuing it at the time of his death.

His first investigations, in collaboration with the late Mr. Rowland Southern, were made over severa years from a floating laboratory on the River Shannon where it flows into Loch Derg. The amount of data they amassed, biological, physical and chemical, was enormous; in studying the diurna migration of the animals they at times kept up their sampling and recording at intervals through the day and night for a week or more on end. The working up of all this material took many years, and their splendid studies of lake and river plankton appeared at intervals from 1926, long after the field work was completed. Southern died in 1935, but Gardiner finished the great work in 1938.

Leaving Ireland, Gardiner was appointed in 192 to the research staff of the Ministry of Agriculture and Fisheries and took up the problems of freshwater biology in relation to pollution at the ministry' laboratory at Alresford. Here came his first serious breakdown in health, and he was forced into exile to Switzerland. On his return he joined the marin Fisheries Laboratory at Lowestoft and devoted himself to such problems as the effects of patchiness in distribution upon the validity of plankton sampling the quantitative efficiency of nets and the vertica distribution and migration of plankton animals Ill-health forced him to resign and go back t Switzerland where, as he wrote in a letter, he wa teaching "Chemistry, Mathematics, 'As you like It' and 'The Acts of the Apostles' in a school for backward boys".

Better once more, Gardiner was appointed in 193 to the staff of the Metropolitan Water Board an threw himself enthusiastically into seeking solutions to the many problems of waterworks biology. H was particularly concerned with the factors underlying the incidence and duration of the diatom outbreaks which are often of such serious consequence in the clogging of filter beds. Having shown that their rate of growth could only be correlated with abundance of phosphate and silicate in the early part of the season, he was investigating the causal conditions acting later in the year. At the time of his death he was experimenting along several new lines of diatom culture and improved methods of estimating populations.

Gardiner never lost his interest in the sea. Thinking that animals must materially alter the phosphate content of the water by their excretion, he took a brief busman's holiday on the research ship *George Bligh* and, by the simplest experiments, with live plankton animals taken straight from the sea, at once proved his contention. This important factor in marine ecology had hitherto been completely overlooked, and much more will be heard of it in the future.

Gardiner's work had a splendid quality. After reading the late Sir Arthur Hill's account of his father ("Obituary Notices of Fellows of the Royal Society", vol. 3, 1941), one realizes that he inherited not only his love of biology but also his keen faculty of self-criticism and clear thinking; he was always striving after improved methods and greater accuracy. His most recent paper, published since his death, s typical of him: a critical examination of the pigment extraction method of measuring phytoplankton production.

I cherish many memories of him: of sharing a study at Oundle, of natural history expeditions with him both at school and in the holidays, of grand days together at sea on the *George Bligh* and latterly of his happy married life in London. From his early school days he was a martyr to asthma, to an attack of which he finally succumbed. All his life he battled with his health, but for ever made light of it. What a spirit he had, what courage, what a grand sense of humour! From a sanatorium in Switzerland he was a frequent contributor to *Punch*. When things must have looked their blackest his letters still sparkled with fun. He will be missed by so many, missed for his cheerful good company, for his intellectual honesty and for his sound reliable work. But for his ill-health how much more he would have done; in spite of it, how astonishing that he did so much! It is good to learn that the Freshwater Biological Association is to assist in the bringing of his unfinished work to publication.

Our sincerest sympathy goes to his wife and to his mother. ALISTER C. HARDY.

Prof. A. A. Read

ARTHUR AVERY READ was born at Honiton, Devon, in 1868 and died at Bournemouth on September 24, where he lived after his retirement from a tenure of forty years of the chair of metallurgy in University College, Cardiff. He was educated at Exeter Grammar School, Owens College, Manchester, and at the University of Sheffield (then the Technical School), where he studied metallurgy under the late Prof. J. O. Arnold. He went to Cardiff from Sheffield in 1894 as the first lecturer in metallurgy, and on his retirement in 1933 he had completed his life's work by the establishment of a department worthy of the University of Wales, housed in a modern building, which had been erected with the financial assistance of the Monmouthshire and South Wales Coal Owners' Association.

Read's enthusiasm for his work was such that the new department flourished, and he had the distinction of training the first man to obtain a B.Sc. degree qualification in metallurgy in Great Britain. Many of his former students have become distinguished men in the metallurgical world.

Read realized that a university has a two-fold obligation—not only to teach but also to prosecute original research; and he managed to keep an even balance between these two while at the same time he worked hard to build and equip his Department. His research work, in collaboration with Arnold, on the chemical relations of carbon and iron with various other elements such as manganese, chromium, vanadium, tungsten, cobalt and molybdenum, which were published over a period of years from 1895 until 1915, have proved of great value in the development of modern alloy steels. His interests in non-ferrous metallurgy resulted in the publication of several papers dealing with alloys of nickel, aluminium and copper, work with which Dr. R. H. Greaves was associated.

Outside College, Prof. Read was interested chiefly in the Volunteers and Territorials, and he received the Territorial Decoration. During the War of 1914–18 he was away from College on national service. After the War the University of Wales, and the College at Cardiff, both young institutions, were faced with serious problems, and Read sacrificed his personal inclination to resume his researches and applied himself energetically to University affairs. He brought to bear on academic matters an administrative outlook which was of inestimable value. His work was recognized by the University conferring on him the degree of D.Sc. *honoris causa*.

Read, always an inspiration to his students, won their respect for his straight dealing and then their affection for his kindliness and his readiness to champion their cause. W. R. D. JONES.

Mr. F. Napier Sutton

FREDERICK NAPIER SUTTON, a former alkali inspector in the Ministry of Health, died on September 24, aged eighty years. He was the eldest son of the late Mr. Francis Sutton, public analyst of Norfolk and Suffolk, and the author of the text-book "A Systematic Handbook of Volumetric Analysis".

Mr. Sutton was, for a very long period, works chemist to Messrs. Baily, Sutton and Co., of Great Yarmouth. In 1885 he was appointed assistant to the chief inspector (the late Alfred Fletcher) under the Alkali, etc., Works Act; he was promoted to sub-inspector in 1892 and to inspector in 1908. He retired on reaching the age of sixty-five in December 1927, having then served for forty-two years, during thirty-five of which he was in charge of the London and south-eastern counties district.

After his retirement and, indeed, up to the time of his death, he continued to take a great interest in the affairs of the Alkali Works Department of the Ministry of Health and in chemical industry generally. During 1892–1916 he was secretary of the London Section of the Society of Chemical Industry.

Mr. Napier Sutton was devoted to chamber and orchestral music, and for many years he was a player in some of the leading amateur orchestral societies. He was an expert trout fisherman, and a gifted 'dresser' of trout flies. He was greatly beloved by all his colleagues, and his passing will be widely mourned.

NEWS and VIEWS

U.S.S.R. Academy of Sciences

At a recent meeting of the Academy of Sciences of the U.S.S.R., thirty-six new academicians and fifty-eight corresponding members were elected. Among the chemists elected were Profs. Dubinin and Nesmeyanov, who have studied the chemistry of metallo-organic compounds, also Profs. Rodionov and Chernyayev, the well-known organic chemists. The geologists included F. Savarensky, a geologist who did valuable work in connexion with the construction of the Moscow–Volga Canal and the Moscow underground railway; Prof. Belyankin, a leading petrographer, who has helped greatly the industrial development of the Urals; Prof. Smirnov, a leading mineralogist of the Leningrad Mining Institute; and Prof. Satpayev, who represents the Kazakhstan branch of the Academy. Among the physicists were Lebedev, the well-known experimental physicist; Khristianovich, who has made investigations in mechanics; Alikhanov, who has studied the physics of the atomic nucleus; and Kurchatov. The biologists included the botanist Sukachev, the histologist Zavarzin and the Ukrainian pathologist Strazhesko. On the applied side, Major-General Blagonravov was elected to the Department of Technical Sciences, as were A. Mikulin, A. Yakovlev and V. Klimov, designers for aviation. The inventor of a new gun, A. Kostekov, was elected and also the Ukrainian economist, M. Ptukaha, who is charged with reconstruction duties.

Post-War World Education

Dr. Grahame Clark has an article in the September issue of *Antiquity* in which he attempts to integrate the various subjects to be taught in schemes for post-war education round the central idea of the evolution of mankind and his place in the universe. In other words, prehistoric anthropology—the study of our common origins—is to be the cement which will bind together the common education of the post-war nations of the world. The article is very interesting and thought-producing, and should be read by all concerned with post-war education. Considered on a university level, there is much to be said for Dr. Clark's thesis; whether his conceptions can possibly be adapted to the primary levels of teaching—to the brain of the child who is necessarily occupied with such problems as the writing of his own language correctly and the doing of his sums—is quite another matter. For, after all, education is not entirely 'book learning'.

Few to-day would deny that the twofold purpose of every educationist concerned with the upbringing of both children and adolescents is, first, to teach them how to live, and secondly to stimulate their interest in and to impart knowledge. Carrying the matter a stage further, the first of these can be subdivided into (1*a*) the art of living alongside one's neighbour, and (1*b*) the power to stand four-square with a reasonable personal independence ***vis-à-vis*** the material world. It is especially in this connexion that the various youth organizations play such an important part, and quite frequently and rightly are closely connected with the schools. The other object of education can be subdivided into (2*a*) the imparting of information useful for technical purposes, for the job in life to be undertaken by the individual, and (2*b*) the imparting of purely cultural information. (Naturally 2*a* and 2*b* often overlap. What is of technical importance for one man may be of purely cultural interest to another—the professional geologist may be interested in Plato, while the classical teacher may have a private passion for geology.) It would appear that it is only with 2*b* that Dr. Clark is in the main concerned. Unfortunately, in the past it has been just this side of education that has least interested the average Englishman, though to-day those who are actively keen on education can detect a change in this respect. There is no doubt that our curricula need an overhaul, and Dr. Clark's plea for prehistory and anthropology as basal subjects should be borne in mind.

District Heating in New York

Current discussions on fuel economy and planning for the future give a special interest to details recently published (*Steam Engineer*, **12**, 222; 1943) of the largest district heating scheme in the United States In the new Parkchester residential community in New York, the central heating of a whole building from one boiler plant gives place to the central heating of a whole district from a single boiler house The site for this vast scheme is an area of 129 acres occupied to the extent of 26·4 per cent of buildings 21·2 per cent of avenues and 51·4 per cent by lawns and walks. Accommodation for 40,000 people is provided in the 42,464 rooms of 51 blocks of flats, along with garages and a theatre. The central boiler plant, housed in a building 180 ft. × 75 ft., and including a chimney more than 300 ft. high, consists of four oil-fired boilers. From these the live steam is circulated on the return condensate system in a vast closed circuit. Instead of fitting a valve on each radiator in a room, a damper is used to control the heat. By this means leakage of air into the closed circuit through a multiplicity of valves is much reduced. The outside walls of each building are heavily insulated by a 1-in. thick spun glass layer together with a layer of air between the brick and plaster of the outside walls. This extra insulation alone is claimed to save £8,000 worth of fuel in a year Details are not given of the thermal efficiency o the transmission system. As the last building was ready for use in 1941, the whole scheme will have had a thorough trial by the time post-war reconstruction begins. The average cost to the individual is abou £2 15*s*. per month per room including heat and light and the flats, consisting of from two to five rooms are designed for people whose income is from £360 to £900 a year.

Medical Research in War-time and the Relie of Suffering

Two recent addresses are deserving of attention in that they deal with new advances in medical research. One is Sir Edward Mellanby's Ludwig Mond Lecture, devoted to a review of medical research in war-time (*Brit. Med. J.*, Sept. 18, 1943); the other is Sir Henry Dale's Frederick Price Lecture (*Brit. Med. J.*, Oct. 2, 1943) on the remarkable recent advances in chemotherapy, all of which have been made in the comparatively short interval between the War of 1914–18 and the present War. Sir Edwar Mellanby refers to "endless references in religious theological, and even philosophical addresses", to the prostitution of science, especially for the purpose of war, and to "some suggestion that there exists in science and scientific men a kind of wickedness not shared by the humanities and by those engaged in their study". This kind of tilting at science is familiar enough. It springs from a failure to recognize that science is neither good nor evil; it is man who uses science for his good or evil ends. No one who reads these two addresses can avoid the conclusion that science can be, and is being, used for wholly beneficent ends and that countless men and women all over the world, as well as countless technicians who assist them, are devoting their lives to the betterment of the lot of humanity and sometimes are losing their lives in this service.

Sir Edward Mellanby's address deals with the organization and duties of the Medical Research Council and with organized medical research on blood transfusion, nutrition, problems of drug supply, the emergency public health laboratory service and the application of medical research to the needs of the fighting services. He inevitably makes contact, through his references to the sulphonamide drugs and to penicillin and other antiseptics, with Sir Henry Dale's more detailed history of these and other pharmacological discoveries. Sir Henry points to future fields of work and to still more remarkable benefits to come. We live, it is clear, in one of the greatest hours of medical history. The depreciators of science should consider, after reading these two records of lives saved, suffering reduced and hope for a better future securely established, whether science, properly used, is not one of the greatest of the humanities. Has any other human activity brought, in so short a time as the interval between the War of 1914–18 and that of to-day, so much effective and practical aid to the sick, the distressed and the broken in mind and limb ?

Glaxo Laboratories' Products

THE flavines or amino-acridines have long been known as antiseptics that are particularly effective in the presence of serum, which diminishes the activity of most other antiseptics. Acriflavine, which is the one generally used, has also trypanocidal powers, hence the name trypoflavine. Glaxo Laboratories, Ltd., of Greenford, Middlesex, have just introduced 2 : 7 diamino-acridine hydrochloride and 5 : amino-acridine hydrochloride. The former is stated to have the least toxicity of all the flavines, and, while not interfering with healing, to be rapidly bactericidal. It is effective against certain Gram-negative organisms not affected by other acridines in similar concentrations. The latter is a non-irritant antiseptic with an anti-bacterial activity similar to that of other flavines and has the advantage of not staining the skin.

Other products which this firm is introducing are nicotinamide, which possesses a similar therapeutic value to nicotinic acid without producing the uncomfortable flushing and other skin reactions so common with the acid, and Suspended T.A.B. Vaccine (synthetic culture medium). It is stated that by using a synthetic culture medium free from the protein and other substances contained in the usual bacteriological broth and nutrient agar, reaction from the use of such substances is avoided. The full antigenic properties of the organisms are retained, while the absence of protein from the culture medium restricts the reaction to that produced by the bacteria themselves. It is claimed that the reactions from this T.A.B. vaccine are few, principally of local pain and stiffness at the site of the injection, while the antigenic response is extremely satisfactory.

Colonial Fisheries Advisory Committee

THE Secretary of State for the Colonies has appointed a Colonial Fisheries Advisory Committee to advise him on problems concerning fisheries (marine and freshwater) in the Colonial Empire, in association with his fisheries adviser. The committee is constituted as follows : The Duke of Devonshire, Parliamentary Under-Secretary of State for the Colonies (*chairman*); Mr. G. L. M. Clauson, Colonial Office (*vice-chairman*); Dr. S. Kemp, director of the Marine Biological Association of the United Kingdom ; Dr. E. B. Worthington, director of the Freshwater Biological Association of the British Empire ; Dr. E. S. Russell, fisheries adviser to the Secretary of State for the Colonies ; Dr. G. A. Reay, director of the Torry Research Institute (Department of Scientific and Industrial Research), Aberdeen ; Dr. B. S. Platt, in charge of investigations into nutrition in the Colonial Empire under the Medical Research Council ; Mr. J. R. Norman, deputy keeper, Department of Zoology, British Museum (Natural History) ; Dr. C. F. A. Pantin, reader in invertebrate zoology, University of Cambridge ; Mr. R. S. Wimpenny, naturalist, Ministry of Agriculture and Fisheries ; Mr. J. Thomson, chief inspector of fisheries, Ministry of Agriculture and Fisheries ; Mr. Morley Neale, member of the firm of Messrs. Neale and West, steam trawler owners, Cardiff ; Mr. C. N. Hooper, clerk of the Fishmongers' Company ; Mr. R. H. Burt, Colonial Office (*secretary*).

Telecommunication

IN his inaugural address to the Institution of Electrical Engineers on October 7, Sir A. Stanley Angwin, president of the Institution, gave a survey of the possibilities of development of telecommunications in the international field, dealing particularly with the subject of international control and regulation and its repercussions on post-war developments in Great Britain. In dealing with international control and standardization, Sir Stanley referred to the various administrative international regulations which had come into being and to the three technical committees which studied technical questions relating to the methods of working communication channels. Reference was made to other international organizations dealing with the application of communication for a particular purpose.

The necessity for emphasis being given to the adoption of a technical basis in determining international frequency allocations leads to consideration of the three consultative technical committees referred to in the address, and the three divisions of the communications with which they deal, namely, telephony, telegraphy and radio communication. Sir Stanley dealt with the provisions to implement these services on an international basis. Reference was made to the possible developments in connexion with television, but how far these will be divided between radio and line transmission has yet to be determined. How far the employment of micro-waves for radio transmission or the new mechanism of electrical transmission by wave guides will meet the needs of television is one of the intriguing problems of the future.

New 50-Kilowatt C.B.S. International Broadcasters

AMONG the foremost short-wave radio broadcast stations in the United States are the C.B.S. International Broadcasters located on Long Island, New York, which transmit around the clock in twenty-three languages and dialects to South America, Central America, the West Indies, Mexico, Europe, Africa and Asia. Inaugurated as a part of the Columbia Broadcasting System on January 1, 1942, the new station now operates regularly with three transmitters simultaneously consisting of two 50-kW. carriers, provided by new equipment designed and manufactured by the Federal Telephone and Radio Corporation, and the 10-kW. carrier of an older unit which was moved to Long Island from Wayne, New Jersey. The transmitters operate with a total of thirteen directive arrays, using nine frequencies from 6 to 22 mc. The antenna design provides a gain of 16 decibels over a conventional half-wave antenna in free space, due to the directional characteristics, making the effective radiation equivalent to almost 2,000 kW.

The C.B.S. station is located on the 1,200-acre site of the Mackay Radio and Telegraph Company's overseas short-wave commercial radio stations on Long Island. In one case, the C.B.S. transmitters are operated on a Mackay antenna simultaneously with Mackay transmission. This is practicable since the type of antenna employed functions efficiently with more than one transmitter, provided the frequencies are separated by at least five per cent. All the C.B.S. transmitters are housed in a new, single-story wing, 40 ft. × 60 ft., with basement, added to the existing Mackay transmitter building. Three exciters and three 50 kW. final amplifiers are provided. The additional radio frequency equipment allows the operators to pre-set the frequency of one radio-frequency section while the other two radio-frequency sections are being operated simultaneously. Instantaneous change-over to the pre set frequency may then be accomplished by operating the specially designed antenna switch. The transmitting equipment is described by H. Romander (*Elec. Comm.*, 21, No. 2; 1943) in an article which deals with the station layout, radio-frequency units, radio-frequency drivers, power amplifier, antenna switching mechanism, modulators, power frequency equipment and control system. Photographs and circuit diagrams illustrate the article.

Birth-rates in Germany

ACCORDING to the *Journal of the American Medical Association* of July 31, the latest figures show a dramatic fall in the German birth-rate. In the large German cities the number of births in 1942 declined by 80,000 from 419,000 in 1940, and the rate per thousand of population fell to 13·9 compared with 17·3 in 1940. In the last quarter of 1942 the rate was as low as 12·7. The experience of the German cities is borne out by the rate for all areas of Greater Germany, which declined from 20·4 during 1939–40 to 15·2 in 1942, a loss of approximately 550,000 live births.

Comet Comas-Sola

A TELEGRAM from Lund announces that Miss Oterma has rediscovered Comet Comas-Sola very close to the position predicted by Messrs. Dinwoodie and Henderson in the "Handbook of the British Astronomical Association", 1943. Its magnitude is not indicated. An ephemeris for November is given below.

Date 1943	R.A. h. m.	Dec.	r	ρ
Nov. 4	02 16·3	+0° 55′	2·314	1·341
12	02 08·3	1 12	2·270	1·319
20	02 00·9	1 43	2·226	1·313
28	01 54·7	2 27	2·184	1·322

The Night Sky in November

FULL moon occurs on Nov. 12d. 01h. 36m. U.T., and new moon on Nov. 27d. 15h. 23m. The following conjunctions with the moon take place: Nov. 14d. 10h., Mars 5° N.; Nov. 14d. 21h., Saturn 2° N.; Nov. 19d. 21h., Jupiter 0·7° S.; Nov. 23d. 18h., Venus 3° S. The following occultations of stars brighter than magnitude 6 take place: Nov. 2d. 17h. 36·8m., 115 B.Sgr(*D*); Nov. 2d. 18h. 23·0m., 121 B.Sgr(*D*); Nov. 15d. 01h. 51·4m., 57 Ori(*R*); Nov. 18d. 01h. 50·9m., θ Cnc(*R*). The times are given for Greenwich and *D* and *R* refer to disappearance and reappearance respectively. Mercury is a morning star at the beginning of the month, rising half an hour before the sun, and is in superior conjunction on Nov. 10. At the end of the month the planet rises at 9h. and sets at 16h. 13m. Venus is a morning star, rising at 2h. 40m. at the beginning of the month, and attaining its greatest westerly elongation on Nov. 16 when it rises at 2h. 53m. At the end of the month it rises at 3h.15m. Mars, an evening star in the constellation of Taurus, sets at 11h., 10h. and 8h. 41m. at the beginning, middle and end of the month respectively. Jupiter, in the constellation of Leo, rises just before midnight at the beginning of the month, and at 23h. 08m. and 22h. 15m. at the middle and end of the month respectively. Saturn is an evening star in the constellation of Taurus. The times of setting at the beginning, middle and end of the month are 11h. 07m., 10h. 08m. and 9h. 05m. respectively. The Leonid meteor shower is due on Nov. 13–14 and the Andromedid shower on Nov. 18–25, but for some years both these showers have been very feeble and in some cases practically non-existent.

Announcements

THE thirtieth Thomas Hawksley Lecture of the Institution of Mechanical Engineers will be delivered by Prof. C. E. Inglis on November 15, at 5.30 p.m. He will speak on "Gyroscopic Principles and Applications".

THE Christmas Lectures at the Royal Institution, the hundred and fourteenth of the well-known series "adapted to a Juvenile Auditory", will be delivered by Prof. E. N. da C. Andrade, Quain professor of physics in the University of London, who will speak on "Vibrations and Waves".

LORD HORDER has been elected president of the British Association of Physical Medicine.

THE Rockefeller Foundation has made a grant of 7,500 dollars as a contribution to be used by Prof. F. F. Nord in connexion with his researches in enzyme chemistry at Fordham University, New York.

DR. L. E. C. HUGHES has been appointed head of the Experimental Department of Messrs. Rediffusion, Ltd., at their works at Wandsworth. Dr. Hughes is technical editor of "Chambers' Technical Dictionary", of which a revised edition has recently appeared.

THE Dominion Government of Canada has approved expenditure for establishing plants and equipment in Montreal and Toronto for the production of penicillin. The appropriation will cover the cost of creating the industry and that of the production of the first 20,000,000,000 units of penicillin for use by the Canadian armed forces. The new industry, employing 250 men and women, will come into operation next February.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Distribution of Nucleic Acid in the Cell

IN a recent article, Stedman and Stedman[1] claim to have discovered a new protein constituent of chromosomes, termed "chromosomin". They allege that Feulgen's reaction does not demonstrate the location of thymonucleic acid in the cell and they conclude that "the staining properties of the chromosomes towards both basic dyes and Feulgen's reagent are due to their content of chromosomin and the evidence indicating the presence in them of nucleic acid is shown to be fallacious". The argument runs as follows: Feulgen's reagent is colourized when in contact with the hydrolysis product of thymonucleic acid. The colourized product (see Baker[2]) is freely soluble in water, and it may then act as an ordinary basic stain and become attached to the acidic "chromosomin". Thus it is sufficient for thymonucleic acid to be present anywhere in the nucleus for the chromosomes to stain with Feulgen's reagent.

Although these authors do not deny that there may be small amounts of nucleic acid in the chromosomes, they lead one to infer that "there is little material left to form the nuclear sap unless this contains some nucleic acid", and indeed they suggest that the spindle at metaphase is a gel of nucleic acid.

The experiments of Mazia and Jaeger[3], however, show this position to be untenable. These workers digested salivary gland cells of Drosophila with nuclease, and then tested for products of thymonucleic acid by means of the Feulgen reaction: controls showed the chromosomes stained and the cytoplasm unstained, while the treated material showed the chromosomes unstained and the cytoplasm stained. The protein constituents of the chromosomes were nevertheless still intact in the digested cells. Nuclease-treated glands, tested by the ninhydrin reaction for protein distribution, showed the chromosomes staining more intensely than the cytoplasm. The action of nuclease is to break up thymonucleic acid, and the products of hydrolysis then become distributed through the cell: these products colourize with Feulgen's reagent, but the dye-stuff so formed does not then become differentially attached to the residual protein of the chromosomes.

The Feulgen reaction is specific for aldehydes and the pentose radicals of thymonucleic acid. Now, however, the properties of the two other constituents of nucleic acid molecules have enabled nucleic acid distribution to be examined, and the results obtained corroborate or overlap the evidence from the Feulgen reaction. The purine and pyrimidine radicals determine the characteristic absorption spectrum of nucleic acid with a well-marked maximum at 2600 A. in the ultra-violet. Caspersson[4] has shown that the chromosomes have a maximum absorption of ultra-violet light at this wave-length, at which indeed their absorption is vastly greater than that of all other cell components. When the same methods were applied to salivary gland chromosomes, Caspersson likewise showed that the bands which are stained with such nuclear dyes as carmine were also the regions of the chromosomes with a high content of nucleic acid. Moreover the contrast between the absorption by the chromosomes and by the rest of the cell (including the spindle) of light of this wave-length remains clear-cut when the protein constituents of the chromosomes have been digested by trypsin; to prove this, it was necessary, of course, that the thymonucleic acid liberated during the digestion should be precipitated by combination with lanthanum ions in the medium.

These experiments did not rule out the presence of nucleic acid derivatives in other parts of the cell. Caspersson and Schultz[5], again by means of the ultra-violet absorption technique, demonstrated concentrations of ribose nucleotides in the nucleoli and cytoplasm of egg cells and rapidly dividing tissues where the Feulgen reaction gave negative results.

The third line of independent evidence for the distribution of nucleic acid in the cell is available from the micro-incineration experiments of Barigozzi and Norberg. Barigozzi[6] showed that the dark-staining bands of the salivary gland chromosomes give concentrations of phosphorus when incinerated. This we should expect since nucleic acid contains phosphorus in every nucleotide whereas most proteins contain little or none. Norberg's[7] results, based on new photometric methods, confirm and extend those of Barigozzi.

Thus while the results of Stedman and Stedman may require that our views on the protein constituents of the chromosomes be modified, there would seem no justification for radical change in the theory of the distribution of nucleic acid in the cell and of its important relationship to various cell functions[8].

H. G. CALLAN.

John Innes Horticultural Institution,
Merton, S.W.19.
Sept. 14.

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[1] Stedman, E., and Stedman, E., NATURE, 152, 267 (1943).

[2] Baker, J. R., in "Cytology and Cell Physiology", edited by Bourne, G. (Oxford: Univ. Press, 1942.)

[3] Mazia, D., and Jaeger, L., *Proc. U.S. Nat. Acad. Sci.*, 25, 456 (1939).

[4] Caspersson, T., *Skand. Archiv. Physiol.*, Suppl. 8 (1936).

[5] Caspersson, T., and Schultz, J., *Proc. U.S. Nat. Acad. Sci.*, 26, 507 (1940).

[6] Barigozzi, C., *Bull. Histol. Tech. Micro.*, 15, 213 (1938).

[7] Norberg, B., *Acta Physiol. Scand.*, 5, Supp. 14 (1942).

[8] Darlington, C. D., NATURE, 149, 66 (1942).

MR. CALLAN, in his defence of the established position of nucleic acid in the nucleus, has completely missed the main significance of our results. Whatever the function of nucleic acid may be, and we have no doubt that it is an important one, and however it may be distributed in the nucleus, its position as the central figure of the chromosomes has disappeared with the discovery of chromosomin. This was the point which we set out to establish in our former article, and we claim that the facts which we have adduced both there and elsewhere[1] give incontrovertible proof of our contention. In dividing cells, chromosomin is quantitatively the major constituent of the nucleus, it is concentrated wholly in the chromosomes, and its presence there supplies for the chromosome theory of heredity a basis which Mirsky[2], and no doubt many others, have recognized could not be filled by either nucleic acid or histone, the only constituents of nuclei hitherto known. We regard chromosomin, in fact, as the chemical basis of inheritance. By this we mean that the type of organism into which a zygote will develop will primarily depend upon the composition of the chromosomin contained in the gametes from which it was formed. We recognize, of course, that it must, within limits, be organized in a definite manner in the chromosomes. Variations within these permissible limits would, no doubt, account for the existence of different hereditary characters, usually ascribed to genes, within a species or race.

When we turn to the question of the distribution of nucleic acid within the nucleus we realize and admit that we are on more controversial ground. Mr. Callan has, rather uncritically, put forward data which, on the whole, constitute a considerable body of circumstantial evidence in favour of the view which he seeks to maintain. Like other evidence of this nature it is, however, susceptible to collapse when new facts emerge. Mr. Callan virtually ignores the new evidence bearing on the problem which our work has supplied.

Before considering the work of others, we must therefore make our own arguments perfectly clear. Our suggestion that the nuclear sap contains nucleic acid was made as a result of our experimental findings. From this it was a short step to the hypothesis, admittedly tentative, that the spindle was a gel of nucleic acid. Let us look at these suggestions from the cytologists' point of view. According to their present conceptions the chromosomes separate from the nuclear sap, at early prophase in the form of a thread of chromosomin. The chromosomes then contract by spiralization until metaphase is reached. Evidently the metaphase chromosomes consist of compressed cylindrical spirals, the hollow interior and the interstices between the spirals being filled with nuclear sap. If nucleic acid is present in the nuclear sap this would almost certainly combine with the basic groups of the chromosomin, thereby enhancing its power to combine with basic dyes. Such a picture, if correct, renders it difficult to decide whether to regard the central core of the chromosomes as constituting part of the chromosomes or part of the nuclear sap. It was to some extent for this reason that we were careful to admit the possibility that the chromosomes contained some nucleic acid.

What evidence have we in favour of our view ? In the first place we have shown that the presence of chromosomin in the chromosomes is sufficient to account for the staining properties of the latter. Even the results obtained with Feulgen's stain can, as we have shown, be interpreted on the same basis ; and, if any doubt still remains about this interpretation, it is completely dispelled by the results which Dr. Choudhuri, who is presenting his evidence separately, has obtained with plant cells. Without preliminary hydrolysis he has succeeded in staining the chromosomes with "developed Feulgen reagent" as effectively as when the normal Feulgen technique is employed [see NATURE, October 23, p. 475].

Secondly, in our analytical work on the composition of various nuclei, we have accounted for practically the whole of their dry weight. This analytical work has, moreover, shown that there are only three constituents (chromosomin, histone and nucleic acid) present in the nuclei in appreciable amount. Of these, chromosomin is contained wholly in the chromosomes while histone is, in some nuclei, present in insufficient amount to form the solid matter of the nuclear sap. Only one conclusion can be drawn from this result, namely, that the solid material of the nuclear sap is nucleic acid. Can Mr. Callan suggest any alternative substance to take its place ? We should add that our suggestion regarding the nature of the spindle has much to commend it. Spindle formation is an almost unvarying phenomenon in mitosis. This fact and the nature of the spindle imply that in all nuclei it is formed from an unvarying substance with the property of forming a viscous solution or gel in low concentrations. Deoxyribose nucleic acid fulfils these requirements.

The case against our suggestions is given in Mr. Callan's letter. There are a few comments which we should like to make.

(1) Mazia and Jaeger's results, contrary to Mr. Callan's opinion, support our view. They found (*a*) that the chromosomes are rapidly and completely digested by trypsin and slowly and incompletely by pepsin ; (*b*) that nuclease, while it destroyed the staining capacity of the chromosomes towards acetocarmine, did so "without affecting the integrity of the chromosomes".

(2) Caspersson had previously shown that chromosomes are rapidly digested by trypsin ; but because the effect was largely inhibited by lanthanum acetate he assumed that, in its absence, the nucleic acid was lost by diffusion. This conclusion overlooks the probability that lanthanum ions also render chromosomin completely insoluble and hence less readily susceptible to digestion.

(3) The use of ultra-violet spectroscopy for the identification of organic compounds is a purely empirical method, and has in the past led to incorrect conclusions even with pure substances. Considerable caution must therefore be exercised when applying the method to fixed or even untreated nuclei. Moreover, if one examines Caspersson's work critically one will find, as he himself admits, that the maximum absorption of the chromosomes does not correspond with the maximum of nucleic acid. From his diagrams the two appear to differ by nearly 100 A., that for the chromosomes being at about 2750 A. Is it a significant fact that this figure is almost identical with the maximum, as determined by Caspersson himself, for tryptophan ? We ask this question because, as we have previously pointed out, chromosomin is rich in tryptophan. If both the necessary chromosomin and the requisite apparatus become available to us, we shall examine this point experimentally.

(4) Norberg's work need not be considered in detail. The author himself only regards his results as preliminary ones. While we do not wish to question the sensitivity and accuracy of his actual phosphorus determinations, we do doubt his ability to separate, by the methods he employs, the chromosomes from the nuclear sap in which they are embedded.

(5) Barigozzi's results are, in our opinion, without significance with regard to the point at issue.

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Effect of Thiourea on the Development of the Amphibian

IT has been shown recently that certain of the sulphonamides and thiourea act as goitrogenic agents in the rat[1,2,3]. These substances have been found also to lower the basal metabolic rate in normal animals[4,5] and to alleviate the symptoms of hyperthyroidism in humans[6,7] by inhibiting the production of thyroid hormone. Since the frog larva is one of the most sensitive indicators of the presence or absence of thyroid material, it became of interest to test the effects of such compounds on the development of the tadpole.

Rana pipiens larvæ were obtained by the method of induced ovulation[8]. Upon reaching the hindlimb bud stage they were immersed in a 0·033 per cent thiourea tap-water solution and fed a diet of boiled spinach throughout the investigation. The thiourea solutions and food were renewed daily. Definite retardation of the metamorphic process was noted so early as the second week. At the end of the third month, the hindlimbs had grown to a length of only 3–5 mm. At this time most of the untreated controls had undergone completely the process of metamorphosis. Although their differentiation was inhibited, the treated animals continued to eat and increased markedly in size and weight. The body and head showed considerable broadening; the viscera were unusually large. Their appearance corresponded to that described for the thyroidectomized tadpole[9,10]. A typical animal, following two months of treatment, measured 90 mm. in total length, 33 mm. in body-length (from snout to base of tail), and had a width (across body) of 19 mm. Its weight was 5·8 gm.; its hindlimb length, however, was only 3·0 mm. None of the several hundred untreated controls employed in this study ever attained such large dimensions.

After about a month of thiourea treatment, most of the animals developed peculiar tail abnormalities characterized by a twisting and thickening confined largely to the base. This effect could not be attributed to any peculiar environmental condition other than the thiourea, since it never occurred in any of the controls kept under similar conditions.

Several tadpoles were allowed to reach a more advanced stage in development (8–10 mm. hindlimb length), and then immersed in thiourea solutions. Here the metamorphic process continued for some time, but at a much slower rate than in the controls. This advance was due probably to the continued release of thyroid substance present in the gland prior to the initiation of experimental treatment.

That the effects of thiourea are reversible was seen from our finding that tadpoles which had been treated with this substance for two months, and then returned to ordinary tap water, promptly resumed their development and became frogs in a relatively short time.

Of especial significance is the fact that the thyroid glands of the experimental animals revealed no enlargement such as has been described in the mammal. On the contrary, the thyroids of tadpoles immersed in thiourea for two months were found to be reduced in size, contained fewer follicles and showed all typical signs of atrophy (for example, low epithelium and colloid retention). Histological studies of thyroids from animals treated for shorter periods of time and with different concentrations of the drug are now being made.

Thiourea does not operate by rendering the body tissues less sensitive to thyroid hormone since we have found that thiourea-treated tadpoles immersed in a solution of thyroxine 1 in 5 million and 0·033 per cent thiourea were transformed rapidly into frogs. Likewise, it has been shown in the mammal that administration of thyroid hormone prevents the goitrogenic action of thiourea and results in a return of the metabolic rate to normal levels[4,5]. Although the evidence is suggestive that thiourea, in the developing amphibian, acts by inhibiting the formation of normal thyroid principle, the question as to whether the drug also affects the production and release of thyrotropic hormone from the pituitary is being investigated at the present time.

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Xanthine Oxidase Activity of Cow's Milk

BOOTH[1] was unable to confirm Wieland and Macrae's[2] observation that the xanthine oxidase activity of cow's milk was low when the sample was freshly drawn but underwent a spontaneous rise when it was allowed to stand in the presence of a suitable preservative. The discrepancy between the results of these workers is probably due to the fact that Booth's samples[3] had already been subjected on the farm to routine cooling, a procedure which, like shaking in air or nitrogen, is sufficient to induce a marked rise in activity[4]. By examining uncooled samples of milk, I have been able to confirm and extend Wieland and Macrae's observations. Twigg[5] kindly informs me that he also has observed the spontaneous rise in xanthine oxidase activity of samples of milk which are allowed to stand after being drawn.

The samples of milk were drawn, into sterile bottles, from Guernsey, Red Poll and Shorthorn cows over the periods December 1938 – July 1939, and March – June 1941. When cooled milk was required, the sample was divided, and one part passed over the 'cooler' within a few minutes of milking. Both uncooled and cooled samples were preserved with thymol and stored at 0–2° C.

Xanthine oxidase activity was determined by methylene blue decolorization and manometrically. In the first method, 1 ml. samples were suspended in phosphate buffer at *p*H 8·0, and allowed to react anaerobically with hypoxanthine or xanthine in the presence of $N/1,000$ methylene blue in a total volume of 5 ml. With a final substrate concentration of 0·0004 M., the activity was low when tested within a few hours of milking, but underwent a spontaneous rise up to the thirty-sixth hour. Some typical results are given in Table 1. Further slight rises were noted in samples retested on the third day, but subsequent increases were not observed, although some milks were retested up to one month after milking. Figures showing the increase in xanthine oxidase activity

TABLE 1.

Sample	$\frac{10^4}{\text{decolorization time in sec.}}$			
	Untreated	'Cooled'	Shaken in air for 20 min.	Allowed to stand for 36 hours
A	45	159	244	250
B	39	134	196	189
C	36	139	200	222

TABLE 2.

Sample	Percentage fat	Activity (as in Table 1)
O–1	0·33	16
O–2	5·90	110
O–3	8·40	180
P–1	0·80	11
P–2	6·00	53
P–3	10·50	78

which occurred when the samples were cooled or shaken are also given in Table 1.

The gradual rise in activity of uncooled samples occurred with varying concentrations of substrate. Thus in final concentrations of 0·0004, 0·0008, 0·0016 and 0·0032 *M*. xanthine, one sample showed activities, expressed as (reciprocal of decolorization time in seconds) × 10^4, of 22, 21, 18 and 10, respectively, when tested eight hours after milking, and of 127, 85, 78 and 72, respectively, when retested on the third day.

In the manometric estimations, the oxygen uptake of 1 ml. samples of uncooled milk, suspended in phosphate buffer at *p*H 8·0, was determined in the presence of varying concentrations of substrate. In a typical sample, the uptake per hour per mgm. of dry matter, in the presence of 0·0008, 0·0016, 0·0032 and 0·0064 *M*. xanthine, rose from 2·72, 3·28, 3·50 and 6·24 μl., respectively, when tested two hours after milking, to 5·76, 6·88, 9·20 and 9·52 μl., respectively, when retested on the third day.

Earlier studies have suggested that, in cow's milk as secreted, xanthine oxidase is in intimate relationship with the fat globules[6,7,8,9,10]. This point was further investigated by estimating the activity of samples drawn at different stages during single milkings, in which the percentage of fat increases from a low level in the 'fore milk' to a high level in the 'strippings' [11]. The initial activity, as determined by methylene blue decolorization, was found to be directly related to the concentration of fat, as shown for two typical samples in Table 2. The spontaneous rise in activity of the samples with a high concentration of fat was marked; the 'strippings' (11·1 per cent fat) from one animal had an activity (expressed as above) of only 39 when tested three hours after milking, and one of 292 when retested on the third day.

Some of the possible explanations of the spontaneous rise in activity, namely, bacterial contamination, oxygen effect, were excluded by the experiments of Wieland and Macrae. Release of activity accompanies aggregation of the milk fat globules[4], and hence coincides with disruption of their surface membrane, a structure which appears to be composed of a complex of phospholipids and a membrane protein, different from other known milk proteins[12,8]. It seems possible that the protein bearer of xanthine oxidase forms part of this membrane, and is secreted in the spread condition, in which it might well be inactive.

Tarassuk and Richardson[13] have recently reported that the lipase activity of freshly drawn milk undergoes a marked rise when the sample is cooled to between 15° and 20° C., and it would be interesting to follow the activity on 'cooling' or standing of other milk enzymes.

I am indebted to Dr. T. F. Macrae for suggesting this work, and to Drs. V. H. Booth, Harriette Chick, J. F. Danielli and M. Dixon for their criticisms. At the time this work was carried out, I was Ministry of Agriculture and Fisheries student in animal health.

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Intracellular Symbionts of Insects as a Source of Vitamins

IN our previous communication on the vitamins of the B group required by insects[1], we pointed out that the difference in the vitamin requirements of two groups of beetles, one comprising Tribolium and Ptinus, and the other Lasioderma, Sitodrepa and Silvanus, was possibly due to the presence, in the latter group, of intracellular symbionts. Tribolium, Ptinus and (unpublished) the moth *Ephestia elutella* require thiamin, riboflavin, nicotinic acid, pyridoxine and pantothenic acid, and, to a lesser degree, choline chloride and biotin as essential growth factors. Lasioderma, Sitodrepa and Silvanus grow successfully in the absence of some of these vitamins, although their requirements differ in detail. The growth of normal larvæ of *Lasioderma serricorne* and *Sitodrepa panicea* and of *Ptinus tectus* on diets containing all the chemically known factors of the vitamin B complex in pure substance (whole diet) and on diets which were lacking in one single B factor are shown in the accompanying table.

In continuation of these experiments, Lasioderma and Sitodrepa have been obtained free from symbionts by surface sterilization of the eggs (according to Koch[2]), and the vitamin requirements of the normal and the sterilized larva have been compared. It is seen in the accompanying table that the vitamin requirements of sterilized larvæ are very different from those of the normal larvæ, and in every respect resemble those of Ptinus. Sterilized larvæ of Sitodrepa grew as well as unsterilized larvæ in the presence of all the vitamins, or in the absence of either *i*-inositol or *p*-aminobenzoic acid. This indicates that sterilizing had no harmful effect provided the diet remained optimal. No growth of sterilized larvæ took place in the absence of the five important factors of the B complex, thiamin, riboflavin, nicotinic acid, pyridoxine and pantothenic acid, and little growth in the

	Lasioderma unsterilized	Lasioderma sterilized	Sitodrepa unsterilized	Sitodrepa sterilized	Ptinus
Whole diet	++++	+++	++++	++++	++++
No thiamin (B_1)	++	—	—	—	±
No riboflavin	++++	—	++(+)	—	—
No nicotinic acid	++++	—	++++	—	—
No pyridoxine (B_6)	++++	—	+++	—	+
No pantothenic acid	+++	—	++	—	±
No choline chloride	++	—	+++	+	++
No *i*-inositol	++++	+++	++++	++++	+++
No *p*-aminobenzoic acid	++++	+++	++++	++++	+++(+)

Efficiency of the whole diet is indicated by ++++. The whole diet consists of casein 50, glucose 50, cholesterol 1, insoluble part of yeast 5, McCollum's salt mixture 2, water 15 parts; wheat germ oil 7 mgm./gm.; thiamin, riboflavin, nicotinic acid, pyridoxine, pantothenic acid and *p*-aminobenzoic acid (50 μ gm./gm. of the dry diet); choline chloride and inositol (500 μ gm./gm.).

absence of choline, while the normal larvæ grew quite well in the absence of any of these vitamins (except thiamin). The results obtained with Lasioderma are similar, the only difference being that sterilized larvæ, in the presence of all the vitamins, or in the absence of inositol or *p*-aminobenzoic acid, grew slightly more slowly than normal ones.

It had been suggested before[2,3] that the role of intracellular symbionts in insects might be to provide accessory food substances, but this is the first experimental evidence in support of that suggestion which has yet been brought forward. Full details of this investigation will be published elsewhere.

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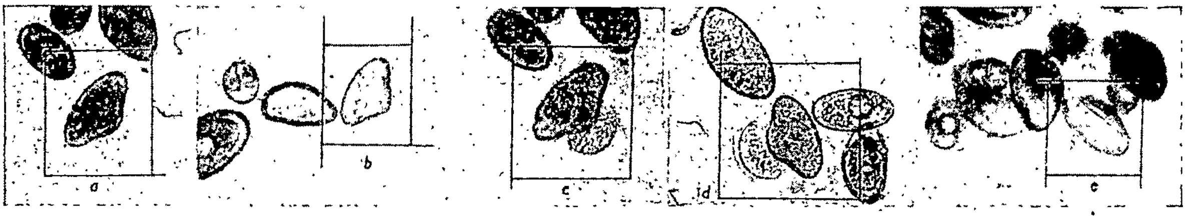
Germination of the Sporangia of Coelomomyces Keilin

ONE of us (J. M.) has found several fungal infections in mosquito larvæ in Northern Rhodesia. The sporangia appear similar or related to those described by Keilin[1], Iyengar[2] and Walker[3], and we tentatively relegate them to the genus Coelomomyces K. So far as we know, no previous worker has observed the germination of sporangia of the genus Coelomomyces, though Keilin appears to have had a shrewd guess as to what was likely to happen.

The sporangia, all thick-walled, which we succeeded in getting to germinate were found in a larva of a species of Mucidus (Dipt. Culicidæ). The process of germination is well shown by the accompanying photographs. A sporangium when about to germinate first loses its oil droplets and the interior becomes granular. (*a*) A slight bulge appears on one side; (*b*) the bulge enlarges, the outer hard shell ruptures and the thin internal membranes appear; (*c*) two thin membranes are now visible, and the contents of the sporangium flows out and is confined within the inner of the thin membranes; (*d*) the two thin membranes are now easily visible and are more widely separated. This, unfortunately, was the last photograph of the actual germination that could be taken. The next, and by far the most spectacular phase, was the sudden coming to life of the zoospores. Up to stage (*d*), no separate zoospores could be seen because of the close packing in the sporangium; with the extrusion of the inner membranes, however, the pressure is released and the spores come to life. Once having started to move around they gradually gain speed until the interior of the sporangium and the extruded thin membranes are a seething mass of zoospores. In a few minutes after the beginning of movement, the zoospores contained within the extruded membrane find their way out to the exterior and immediately swim out of the field of observation. More zoospores from inside the sporangium take their place, and gradually the whole empties itself and all that is left is a sporangium with a rent through which the thin membranes had extruded (*e*).

The time taken to reach the stage shown in (*c*) may be a day or two. Once the zoospores flow into the extruded thin membranes, complete liberation takes place in a few minutes. During the act of leaving the sporangium one does not gain the impression that the extruded membranes suddenly burst, because they appear to remain intact, and zoospores leave gradually as if they were capable of penetrating the thin membranes without rupturing them. The zoospores have a single flagellum. The body measures about 4 μ, and the length of the flagellum is approximately four times this length. They progress head first and the flagellum is not undulated but whipped rather stiffly from side to side.



We are indebted to Dr. S. Selby of Johannesburg for the loan of his microphotographic apparatus, which made it possible for us to make a large number of exposures with the minimum delay.

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Stereomorphism in Cryptic Coloration of Lepidoptera

Cryptic effect, that is, the inconspicuousness of the organism in its natural environment, depends upon three main causes: (1) the coloration of the cryptic organism should resemble that of the surroundings; (2) the body-shape is often modified to resemble environmental components (stick insects, etc.); (3) the effect is that of a quiescent organism and not of a moving one, and the attitude of rest and the bodily components are exactly adapted to each other. According to Oudemans' rule[1], the cryptic colours of resting Lepidoptera are the only visible ones, while all the bright telechromatic[2] areas are concealed. The above three groups of factors form a definite system independent in a way of other bodily systems and using the body, as it were, as a sort of substratum irrespective of its organs. The term 'cryptom' may be given to the system.

According to Thayer's principle of counter shading[3], the orderly distribution of colours is largely responsible for the effectiveness of the cryptom, the main result of the working of the principle being that the convex bodies, for example, of birds, are rendered visually flat. The cryptoms of Lepidoptera, and especially Rhopalocera, are mainly located on th wings. Because the latter are flat, Thayer's principl is not applicable to them. Using stereoscopic apparatus and the method of stereomodels, I was able t show[4] that cryptoms of this sort are governe by the principle of stereomorphism[5], that is, that o cryptic wings two-dimensional images are present so that the relation of the flat cryptom to som hypothetical microlandscape corresponds to that o a photograph of a landscape and the landscape itself On these stereomodels the pattern components ar imitated by shadows cast by their sculptured non coloured surface (see illustration). The relief of th latter may be very complicated according to th cryptom copied, and consists of a number of raise and lowered areas which are generally curved an often pass into one another by gentle alterations o their directions and inclinations.

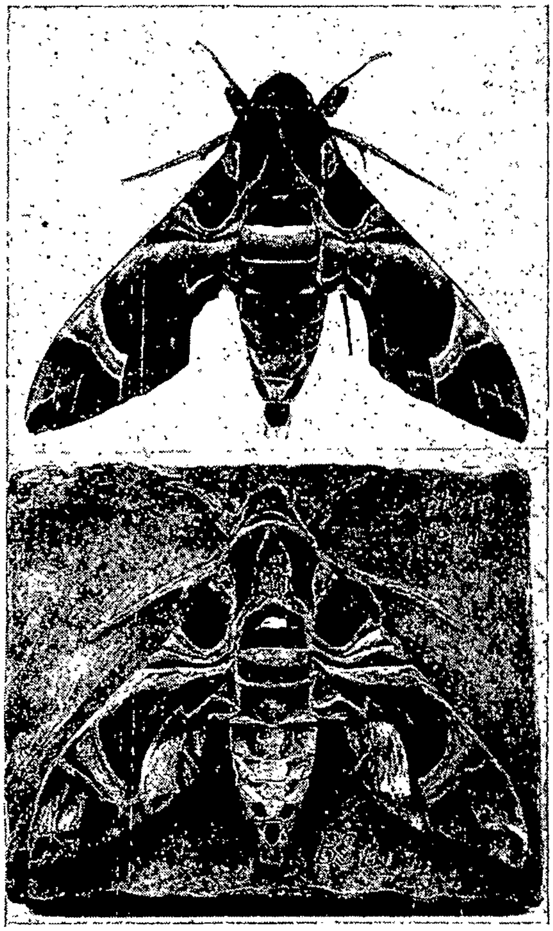

Fig. 1. (Above): A specimen of the hawk moth, *Daphnis nerii* L. (Below): A clay monochrome model of the above moth in which the colour pattern is imitated by the distribution of shadows on the sculptured surface of the model. The method proves that the colour pattern of the moth represents a two-dimensional reproduction of hypothetical three-dimensional bodies. Due to this, the cryptic effect of this sort of coloration is very strong.

But in Cott's excellent book[6] the above model are described as consisting of "different surface lying in the same plane but on different levels", an it is argued that the surfaces in question should b regarded as sloped and curved. My paper is illustrate by the model of *Erebia lappona* chosen as a ver simple example of the method and consisting as matter of fact of flat surfaces. But in the text, "protuberances and depressions of different shape an size" seen through stereoscopic devices are spoke of, and mention is made of the model of *Daphni nerii* illustrated in the accompanying figure. Thi model consists of a number of variously sloped surfaces, many of them being curved. It was exhibite at a scientific meeting in 1939 and the photograp published in 1941[5]. The basic idea of the researc in question is "that the wings of moths and butterflies imitate bark, leaves and the like"[4]. Because th typical surfaces of objects of this sort are curved the surfaces of models could not be restricted to fla shapes. The latter should be regarded as a particula example of a surface normally curved. Thus Dr Cott's interpretation of my models and my own view are at variance.

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Binucleate Oidia on Binucleate Myceliun of *Polystictus hirsutus* Fr.

Brodie[1] remarked that the occurrence of binucleate oidia on binucleate mycelium of basidiomycetous fungi is rare. The only example cited s far seems that of *Pholiota aurivella* Batsch by Vandendries and Martens[2].

While carrying on pairing experiments with closel related species of Polypores on agar films on slides I came across an oidial strain of *Polystictus hirsutu* which is heterothallic and bipolar[3]. This was paire with *Polystictus steinheilianus* Berk. and Lev. (a non oidial one). Binucleate oidia in four or five shor chains arising direct from binucleate hyphæ of *P* *hirsutus* with clamp-connexions were obtained clos to the line of demarcation between polysporou cultures of the two closely related species, and ther was a number of hyphal fusions between hyphæ of *P. hirsutus* and *P. steinheilianus* at the line of demarcation. Farther away from the line, monocaryon oidia in short chains like the fingers of the human hand were found due to haploidization of the binucleate hyphæ of *P. hirsutus*, no clamp-connexions having occurred on the oidial hyphæ. In single (polysporous) culture of *P. hirsutus*, only monocaryon oidia were obtained, as noticed by Brodie in dicaryon mycelium of *Collybia velutipes*. So the presence of binucleate oidia in this case may be ascribed to the influence of pairing of *P. steinheilianus* on *P. hirsutus*.

For the observation of nuclei in oidia the agar-films were fixed in Allen's bouin and stained with Haidenhain's iron-alum hæmatoxylin. Dicaryon oidia were cylindrical while monocaryon oidia were oval.

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A Case of Club-Root of Swedes Due to a Seed-borne Infection

CLUB-ROOT caused by *Plasmodiophera brassicæ* Wor. is one of the most serious diseases to which cultivated Brassicas are subject. The disease usually results from the planting of susceptible crops in contaminated soil, and the general assumption is that the infection is contracted from the soil. So far as I am aware, the relevant literature contains no record of an outbreak of the disease traceable to the use of contaminated seed. Three outbreaks of the disease which occurred in 1942 and 1943 in a Manchester garden could not, however, be traced as being due to a soil contamination. A survey of all attendant circumstances showed no previous Plasmodiophera history in the immediate locality or contributory circumstance by which it could have been introduced into the garden, and the evidence pointed to a seed-borne infection.

As a small quantity of seed which had given rise to a diseased swede crop was available, experiments were carried out, designed to show, if possible, whether or not the disease had been seed-borne. If, in fact, the seed was infected, then a surface contamination with infected soil resulting from contact of the fruit with soil either before or during harvest was suspected, and the experiments were made with this possibility in mind. All sowings were made in boxes of compost and all the compost components and the containers were effectively sterilized. Fertilizers were added to the mixture as recommended for John Innes compost but no lime was added.

For each variety, one box was sown with untreated seed and one with seed 'surface sterilized' with hypochlorite. As controls, two boxes of Cambridge No. 5 Brussels sprouts were used. The Brussels sprouts seed had previously given disease-free plants. Two further boxes of Brussels sprouts were sown and immediately after sowing watered with swede seed washings obtained by soaking the swede seed in distilled water over-night.

Seed was sown on July 22. Germination was good in all boxes, and the seedlings grew satisfactorily. By mid-September some of the swedes had developed swellings at the bases of the hypocotyls and typical clubbed roots; in the cells of which numerous plasmodia of *P. brassica* were present. All the plants were harvested and minutely examined on October 1, and the data obtained are assembled below:

	Total number of plants	Per cent infected
Swede, var. Best-of-all		
Untreated seed	40	52·5
Surface sterilized seed	46	41·3
Brussels sprout with Best-of-all swede seed washings	27	0
Swede, var. Conqueror		
Untreated seed	45	15·6
Surface sterilized seed	63	1·6
Brussels sprout with Conqueror swede seed washings	30	16·7
Brussels sprout		
Untreated seed (1)	42	0
Untreated seed (2)	63	0

The small amount of seed available precluded the carrying out of any more elaborate experiments, but the results obtained point clearly to the disease in the swedes being seed-borne. Further, the results obtained are entirely explicable if there is surface contamination of the seed; and surface sterilization of the seed with hypochlorite is no more, or not much more, effective in removing this than washing with water alone. Whereas the contamination of the Conqueror swedes is easily removable, that of the Best-of-all swedes is more adherent, with the result that while Conqueror seed washings cause infection of Brussels sprouts, the Best-of-all seed washings fail to do so. The conclusion that the disease is seed-borne and in one case at least (and probably in both) due to surface contamination appears inescapable.

Having established that club-root may appear in brassicas because of a seed-borne infection, some points of considerable importance are raised.

To determine what proportion of new outbreaks of the disease is in fact due to this cause is well-nigh impossible as so rarely is suspected seed available for experimental purposes. Nevertheless, even if the proportion is small and the risk of introducing the club-root organism into clean ground by this method remote, the development of suitable methods of seed sterilization may be worth while, while the importance of growing brassica seed crops only on clean land is clearly indicated.

I am indebted to Dr. H. J. Western for confirming my identification of *P. brassica*.

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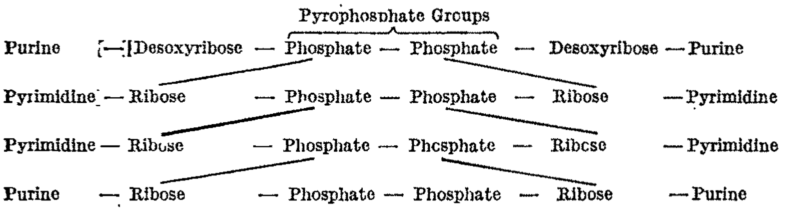
Oct. 7.

A Speculation on the Nature of the Chemical Structure which is the Essence of the Malignant Cell

ALTHOUGH it must be presumed that the chemical constitution of the cancer cell diverges in some subtle yet profound manner from the non-malignant, up to the present definite suggestions as to the manner of this difference have not been formulated in terms of atoms and molecules. Thus evidence for abnormal respiratory exchange has been adduced by many investigators and rebutted by other workers; the secret of malignancy has been attributed to chromosome abnormalities, to gene mutation, lack of hormone balance, irregularity of enzyme constitution, etc.

The concept submitted below is possibly little more than an integration of current ideas, but it is set forth because this simple chemical aspect has stimulated us to what we believe to be intelligently planned if, thus far, unfruitful experiments. It may occasion useful criticism and clarification by others who can bring to bear upon it diverse aspects of knowledge.

The essence of the idea is the formulation of a molecule in the chromosome capable of splitting into two similar symmetrical portions. Visualization of the severance of this molecule during division of the chromosome gives a picture of the vital process of reconstitution of this most important nuclear material in each 'daughter' cell. Further, in the case of the malignant cell, the molecule is to be conceived as impelled on a course of irreversible division. In the chromosome itself, no doubt associated with other nuclear constituents, there would be a vast marshalling of such molecules in the cleavage plane. The specific molecule envisaged is a nucleic acid linked through pyrophosphoric acid to nucleotide groups.


Pyrophosphate Groups
Purine — Desoxyribose — Phosphate — Phosphate — Desoxyribose — Purine
Pyrimidine — Ribose — Phosphate — Phosphate — Ribose — Pyrimidine
Pyrimidine — Ribose — Phosphate — Phosphate — Ribose — Pyrimidine
Purine — Ribose — Phosphate — Phosphate — Ribose — Purine

There is much evidence that compound nucleotides, some of them exhibiting this pyrophosphoric group, are of great importance in cellular processes, for example, co-dehydrogenase I, thiamine pyrophosphate (co-carboxylase), riboflavine-adenine dinucleotide, and phosphagen, while the active principle of embryonic extract which promotes growth of cultured tissue, and possibly the milk factor of inherited mammary cancer in mice, may possess this structure. Consideration of the behaviour of viruses, which have attributes of a living organism and of a pure chemical, gives support to such an idea. It has been suggested that when such an entity multiplies, it does so by laying down a copy of itself on a 'template' system.

We suggest, then, that in the 'resting' phase, that is, when engaged in ordinary cellular activities, the cell has, as its essential basis, molecules of nucleic acid joined by pyrophosphoric linkings to nucleotides similar to those mentioned above which subserve its normal metabolic activity. When cell division is about to take place the metabolic nucleotides on one side of the linkage are replaced by, or are converted into, nucleotides which are the mirror image of those on the primary nucleic acid portion. The symmetrical, double nucleic acid then splits, with resultant division of the chromosomes accompanied by the associated phenomena which comprise 'cell division'.

In the case of the malignant cell, however, we would postulate that because of the abnormal juxtaposition of specific side chains, or the presence of abnormal linkings in such groups, the symmetrical development of the dual nucleic-acid molecule proceeds directly and continually instead of via the usual attachment of the metabolic type of nucleotide groups.

The factors determining the abnormal production of nuclear material might, therefore, be various, that is to say, any of the agencies which we term carcinogenic; for example, the effects occasioned by the chemical or physico-chemical attachment of the well-known carcinogenic chemicals or their reaction products, by radioactive elements, X-rays or light waves, or more directly by a virus which in itself is a compound tetra-nucleotide which undergoes division with little 'metabolic' activity.

On this hypothesis the rapidity with which a virus may induce tumours in certain organisms compared with the slow influence of pure chemicals and hormones would be explicable, while the apparent anti-cancer influence ascribed to some vitamins of the B complex and also the role of co-carcinogens could be interpreted in terms of chemical structure. The disappearance or alteration of normal cell function in many cases could also be inferred, while the occurrence of simple tumours and various grades of malignancy can all be comprehended as governed by such a mechanism operating through the pyrophosphoric di-nucleic acid structure.

Recently Stedman and Stedman[1] have described a protein component of cell nuclei present in much greater proportion than nucleic acid, but the discovery does not necessarily overthrow the belief that nucleic acid is the master constituent. The chromosomin moiety may play a most important part in providing the requisite environment for the elaboration of the 'double' nucleic acid.

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Birmingham, 15. Sept. 29.

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[1] Stedman, E., and Stedman, Mrs. E., NATURE, 152, 267 (1943).

Flinders Petrie's Racial Types

IN 1887, the British Association published the report of a committee which had enabled the late Sir Flinders Petrie to photograph and make casts of a large series of 'Racial Types' from Egyptian wall-reliefs and frescoes. A limited edition of prints was published and has become very rare. In the report of the committee it was stated that the negatives were deposited with Mr. Browning Hogg, 75 High Street, Bromley, Kent, who would supply prints. It has been ascertained that Mr. Hogg ceased to live in Bromley after 1888; but the Association has no record concerning the negatives subsequent to 1887. It is now desired to trace them if by any means possible, since a number of these 'Racial Types either are not included in Max Burchardt's series (c. 1913) or are much better photographs, and no later work of this nature has been done. The Association will be grateful for any information.

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(Secretary.)

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RESEARCH ITEMS

The Naivasha Fossil Skull and Skeleton

These interesting remains were excavated by Dr. L. S. B. and Mrs. Leakey in July and August 1940 from a very rich prehistoric site at the base of a cliff a few miles from Naivasha (*J. E. Africa Nat. Hist. Soc.*, 16, 169; June 1942). Most of the skeleton was *in situ*. A large number of artefacts, mainly obsidian implements and fragments of implements, was found in the same silts. This associated industry somewhat resembles that known as Upper Kenya Aurignacian Phase "C", but may prove to be a slightly later date, as yet unnamed. The relationship of this Naivasha skull and skeleton to other East African prehistoric skulls is not at all easy to determine. Leakey's conclusion is that it probably resembles a male of *Homo sapiens* type, and is dated as belonging to the closing phase of the Gamblian Pluvial, after the second maximum of that Pluvial had passed. The skull is long and very narrow, with the very low cranial index of 64·52. The type represented has no very close affinity to any other prehistoric types from Kenya, though it bears a certain resemblance to the Oldoway skull from Tanganyika Territory, which is also attributed to the closing stages of the Gamblian Pluvial and is probably connected with a late stage of the Upper Kenya Aurignacian culture.

Density of Certain Marine Organisms

Interesting data that throw light on the relationship between certain marine organisms and their environment and mode of development are reported by A. G. Lowndes (*Proc. Zool. Soc.*, Ser. A, **113**, 28; 1943). In decapod Crustacea the resting ovaries have a density approximating to that of protoplasm (1·0565) but the ova have a much higher density (1·1129 for *Maia squinado*), and the early embryos are so dense (1·1170) that they would be unable to swim and to lead an independent life. They possess an appreciable store of food and are carried by the females; they become free-swimming only when their density has fallen. In the copepods, when the zygotes are extruded there is a great increase in volume due to water absorption and a corresponding decrease in density, so that embryos of low density and capable of an independent existence result. The data for the Echinodermata are fewer, but they show that in four species, as the ova develop, their density decreases, so that the early embryos have such a low density that they can be supported in the water by their own cilia, and this obviates the necessity of a large food store in the ova and of carriage by the females, and permits the early assumption of a free-living habit.

Fishes from the Phœnix and Samoan Islands

Leonard P. Schultz reports on a large number of fishes from these islands, collected in 1939 during the Navy Survey Expedition of the U.S.S. *Bushnell*, to which he was attached as naturalist (U.S. Nat. Mus. *Bull.* 180, 1943). This unique opportunity for securing rare and interesting material resulted in the capture of an enormous number of fishes, upwards of 14,000 being collected, with about 3,000 specimens of other groups. Thirty new fishes belonging to six new genera are described and many new records are given. There are useful keys to species, and, in some cases, to genera and families; and the report is illustrated by diagrams, figures and plates. Valuable colour notes are included, taken at the time of collection. Among the larger fishes the order Apodes is well represented, the genera belonging to six families, seven species being new. Of the smaller fishes there are many gobies, including thirty-four genera. The report is purely systematic and no notes relating to the natural history of the different fishes are given.

Interspecific Translocation of a Chromosome Arm

A. Håkansson (*Hereditas*, 29, 141; 1943) has examined the progeny of a hybrid between *Godetia Whitneyi* and *G. deflexa* created by Hiorth. By repeated back-crosses a red-nerved plant with fifteen chromosomes was obtained which produced a large deficiency of red-nerved plants in its offspring on crossing to normal fourteen-chromosome *G. Whitneyi*. The extra chromosome presumably carrying *R* for red-nerves was eliminated during meiosis. By X-raying such red-nerved plants Hiorth found a plant which segregated fifty-five red-nerved to sixty-four normal plants, that is, almost equality. Håkansson found that this plant has fourteen chromosomes and forms bivalents regularly, but that one pair of bivalents was heteromorphic. There is no sign of pairing of the longer arm of one member of this bivalent and it presumably was derived from *G. deflexa*, whereas the rest of the chromosomes were derived from *G. Whitneyi*.

Silver Compounds as Fungicides

The toxic action of silver compounds for certain fungi has been known for a considerable time, but the high cost of silver and the awe of its being a precious metal doubtless inhibited any extensive exploitation of its fungicidal properties. Lowell W. Nielsen, however, has made extensive tests of silver compounds as the toxic agents for spray fluids (Memoir 248, Cornell Univ. Agr. Exp. Sta., Ithaca, N.Y.; November 1942). The trials were all made in an inoculation chamber, using the potato and *Phytophthora infestans* as the host and parasite respectively. Several silver compounds and mixtures gave promising results, the best being a combination of silver nitrate, ferrous sulphate and lime in the approximate proportions 15 : 25 : 15, and diluted with water to a strength of 100 p.p.m. of silver. This mixture had also satisfactory adhering qualities. The experiments are part of the search for a spray fluid which would be less harmful to certain kinds of foliage than those commonly used. They establish the most useful mixture, but do not yet include field trials, or any economic evaluation, though the estimated cost for materials of about one cent per gallon of spray fluid does not appear excessive.

Chemical Evolution of the Ocean

E. J. Conway has discussed in illuminating detail the principles governing the composition of ocean water and its variation during geological time (*Proc. Roy. Irish Acad.*, 48, B, 9; 1943). The main hypothesis is based on the assumption that the ocean volume has remained essentially constant, with additions of chlorine either from the original atmosphere or from volcanic sources. A subsidiary hypothesis based on the idea of a growing ocean fed by juvenile water is more briefly treated. It is shown that the removal of potassium from the ocean by living organisms, with subsequent conversion to glauconite, has played a major part in the chemical evolution. A noteworthy effect which may be correlated with the large-scale appearance of fossils in Cambrian time was to bring about a marked increase in the concentrations of calcium and magnesium ions and a corresponding decrease in the sulphate concentration. The oceanic composition of the early Ordovician period—about the time of the first appearance of vertebrates—is compared with the composition of mammalian blood plasma. The oceanic salinity was then about three times that of such plasma and had a different composition pattern, particularly with respect to calcium and magnesium. It is pointed out that the apparent discrepancy between the age of the ocean as measured by chemical denudation and that of the oldest rocks dated by radioactive methods tends to disappear when account is taken (*a*) of sodium deriving from rock silicates alone, and (*b*) of present-day factors which lead to abnormally high rates of denudation. The paper is highly original in methods and fruitful in results, and deserves careful study by all who are interested in the geochemical history of the oceans.

Erratics of the Cambridge Greensand

IT is well known that the Cambridge Greensand has yielded a great variety of erratic pebbles and boulders. L. Hawkes has made a careful study of the collection of 163 erratics housed in the Sedgwick Museum, Cambridge (*Quart. J. Geol. Soc.*, 93–104; 1943). About forty different types of sedimentary, igneous and metamorphic rocks have been recognized. Two boulders may be matched with the paisanite of Mynydd Mawr, North Wales; others with the Uriconian rocks of the Midlands and Welsh borders; but the majority, two of which are of types unknown in the British Isles, cannot be localized. The boulders were floated to the Cambridge region, probably in the roots of trees, during the period of formation of the Greensand deposit. They prove that land existed at this time in North Wales and adjoining areas, probably as a peneplain of Lower Palæozoic and Pre-Cambrian rocks diversified with monadnocks such as Mynydd Mawr. The prevailing currents appear to have been from the west, and it is surmised that nearly all the erratics could have been derived from land in this direction, with Northern Ireland as a probable source for the schists and gneisses of the collection.

Sub-Crustal Structure of New Zealand

THE structure of the earth's crust immediately beneath New Zealand has recently been investigated by R. C. Hayes ("The Subcrustal Structure in the New Zealand Region from Seismic Data", by R. C. Hayes, *Bull. Seismological Soc. Amer.*, 33, No. 2, April 1943). The author states that it has become evident from recent investigations that there is some definite arrangement in the distribution of earthquake origins in the New Zealand region. Earthquakes originate below normal depth in many parts of the region, depths of several hundred kilometres occurring beneath the volcanic zone in North Island. Depths of focus have been plotted. The results seem to show the existence of a discontinuity of more or less regular form, its depth varying from about 30 km. in some places to a maximum of more than 350 km. It is suggested that the material below this discontinuity is so viscous as to have been distorted by plastic flow into folds, the most marked one having its crest along the east coast of North Island from near East Cape to south of Cook Strait. Its slope appears to be very steep toward the north-west. Above the discontinuity earthquakes occur, and recent major shocks at various points near the crest of the fold suggest that it continues to be forced upward, causing fracture and fault-slipping in the more brittle material above.

Synthesis of Succinic Acid

A NEW synthesis of succinic acid $(-CH_2COOH)_2$ is reported by M. S. Kharasch and M. T. Gladstone (*J. Amer. Chem. Soc.*, 65, 15; 1943), in which acetyl peroxide dissolved in glacial acetic acid is dropped slowly into glacial acetic acid maintained at 95°–100°. A mixture of methane and carbon dioxide is evolved. The acetic acid was removed by distillation in vacuum and the residue when crystallized from water gave succinic acid. With *iso*butyric acid, tetramethylsuccinic acid was obtained, and with chloracetic acid, *meso*-dichlorosuccinic acid. It is supposed that a free radical mechanism is involved:

$$(CH_3CO)_2O_2 = CH_2\cdot + CH_3COO\cdot + CO_2$$
$$CH_3COOH + CH\cdot = \text{complex} = CH_4 + \cdot CH_2COOH$$
$$2\cdot CH_2COOH = (-CH_2COOH)_2.$$

Flow of Viscous Fluids

ABOUT the problems of fluid flow which commonly arise in engineering practice a large amount of information has been collected by experimental methods. In six notes (A. Fathy, S. Bishara, S. A. M. Hassanein, Physical Department Paper No. 44, Government Press, Cairo, 1943) the theoretical aspect of these problems is approached by methods which differ from those usually adopted both in respect of the mathematical statement and of the empirical simplifying assumptions. The notes comprise: analysis of motion in natural co-ordinates (stream-lines and their orthogonal trajectories); critical state of flow (particularly in channels); non-uniform flow in open channels; frictional conditions and velocity distribution in turbulent flow; flow through circular pipes; breakdown of the laminar state of flow.

Photovisual Magnitudes of Double Stars

A. W. J. COUSINS has a paper with the above title (*Mon. Not. Roy. Astro Soc.*, 103, 3; 1943) which describes the measurement at Durban Observatory of photovisual magnitudes for 119 stars in the southern hemisphere. Fabry's method, which was used very successfully by the late E. G. Williams and H. Knox-Shaw, at the Radcliffe Observatory, Pretoria, to determine the magnitudes and colours of *O*- and early *B*-type stars south of −35° declination, was adopted, but in the present case stars of all spectral types are included. A full description of the apparatus which was used is given, and there are tables showing the results obtained. The standards used for the determination of the zero point were the photovisual magnitudes of eight of the brighter stars of the Pleiades, which Calder obtained in 1937. When reduced to the Harvard photovisual system it was found that there existed differences of scale and zero point and also a large colour coefficient. After applying certain corrections for atmospheric extinction (a serious source of error in employing Fabry's method for this class of work), the mean deviation between the two series is ± 0·09 m. On comparing the results with 11 *B*-type stars which were also observed by Williams, the mean deviation was found to be only ± 0·025 mag.

CULTURE AND MANUAL SKILL

By C. W. HANSEL

A CRITICAL analysis of the traditional classical education in Britain reveals in many of its rotagonists a narrow and prejudiced outlook, almost pride in ignorance of science, and a contempt or manual skill. They seek to apply to the social roblems of to-day a strangely perverted form of hat they regard as the best ideas and practices of reek times. Their choice and adaptation have been nfortunate, because much that is worthy of imitation as not been followed, and a great deal of inferior ubstitution has been made. Traditional classical ducation lies nearer to scholasticism than Hellenism. t is unbalanced in its blindness for everything except ook learning, and it is dangerously inadequate in hat it ignores the many and only partially caters or the few. Further, it is apparently unaware of he complete transformation of civilization which has esulted from the progress of science, industry, and he arts.

Sir Richard Gregory has said, "There has always een a lag between stages of scientific knowledge nd social or moral wisdom. What is particularly eeded to-day is to promote public interest in the lose relationships of natural science with other umanistic studies which influence the thoughts and ctions of all citizens."

The education of the Greek, at the time of Plato, onsisted, up to the age of about seventeen, of very imple instruction in the three *R*'s, music, and dancing r gymnasium. Then followed a period of compulsory ublic service from seventeen to twenty. If worthy f further education, from twenty to thirty he studied athematics and science, but not to the neglect of ublic duty. Philosophy was reserved for later life. here is much that is attractive in this system. here is no forcing of the pace, but a natural growth f the mind. There is an insistence on national ervice from everyone. There is recognition of educaion as a life-long process, schooling being merely art of it. Education is cultural not vocational, the ne object of leisure. There is the exclusion of abstract nd philosophical discussion from the education of hose lacking maturity and experience. There is an mmense and just appreciation of the mother tongue. nly two matters call for criticism: the undue mphasis on memory and the veneration of warlike ursuits: "Pallas I celebrate, sacker of cities, terrible oddess of war" (Aristophanes).

How has Greek education been modified in the raditional classical education of Britain? Every esirable feature of the Greek system has been hanged or eliminated and almost every undesirable ature of scholasticism has been retained. The chool retains the seclusion of the monastery; it is sually unconnected with home life and with the ommunity in which the pupil will afterwards live is life. Far too much is attempted for the mind f the young pupil to expand naturally, with the esult that the English language and literature are eglected in the attempt to cover excessive detail a multiplicity of subjects by sheer memorization nd imposed instruction instead of naturally acquired nowledge through the medium of concrete experience and self-instruction.

One of the most serious defects of classical instrucion is the contempt it breeds for manual skill. his is one of the legacies of Greece and Rome. Archimedes is not mentioned in the twelve volumes of Grote's "History of Greece" or the eight volumes of Thirlwall. Quoting from the Langhorne translation of Plutarch's "Lives": "Eudoxus and Archytas who gave a variety and an agreeable turn to geometry, and confirmed certain problems by sensible experiments and the use of instruments, which could not be demonstrated in the way of theorem. . . . But when Plato inveighed against them, with great indignation, as corrupting and debasing the excellence of geometry, by making her descend from incorporeal and intellectual corporeal and sensible things and obliging her to make use of matter, which requires much manual labour, and is the object of servile trades; then *mechanics* were separated from geometry, and being a long time despised by the philosopher, were considered as a branch of the military art." "Archimedes . . . considered all attention to *mechanics*, and every art that ministers to common uses, as mean and sordid, and placed his whole delight in those intellectual speculations, which, without any relation to the necessities of life, have an intrinsic excellence arising from truth and demonstration only."

Quoting from a Royal Institution lecture by Prof. Benjamin Farrington: " 'What are called the mechanical arts', says Socrates, 'carry a social stigma and are rightly dishonoured in our cities.' " "The word surgery is, of course, simply the modern form of the Greek cheirourgia, which means manual operation. And we shall find reason for connecting the decline of anatomy after Galen with the ancient prejudice against the cheirourgos, the surgeon or manual operator." "That the Greeks early acquired a contempt for manual labour is certain. 'The noble are those who have escaped the yoke of manual labour' (Herodotus)." " 'The sick in our cities', writes Plato in the *Laws*, 'are of two classes, the slaves and the free.' " "Theirs were the crafts which Aristotle defined as being necessary for the existence of the city but as disqualifying their practitioners from citizenship."

The denial of culture to the craftsman is surely born out of an entirely unbalanced education and a completely mistaken and narrow view of culture. Culture proceeds from all those activities of mind and body that are worthy of cultivation. Matthew Arnold once said "culture unites classes"; this can scarcely refer to a state of mind which fails to recognize the dignity and worth of labour and manual skill.

Sir Richard Livingstone in "Education for a World Adrift" (see NATURE, May 8, 1943) speaks of "spiritual values" and the "noble ideals of Hellenism". The "Age of Science" he identifies with an "Age without Standards". He finds in Greek literature (even in translations) a "philosophy of life" not to be found elsewhere. Does he prefer the inhuman recital of strife, intrigue, and cruelty, for example, in Plutarch's "Lives" to what youth may learn from Smiles' "Lives of the Engineers"? Does he prefer to dwell on "the torture of the boat" rather than on the work of Lister or Pasteur? He asserts that science is non-moral and unconnected with standards of value. Has he read the second Huxley Lecture of the Anthropological Institute, by Francis Galton (see NATURE, Oct. 29, 1901)?

Sir Benjamin Brodie, in an address to the Royal Society (1859), said: "Physical investigation, more than anything besides, helps to teach us the actual value and right use of the Imagination—of that wondrous faculty, which, left to ramble uncontrolled, leads us astray into a wilderness of perplexities and errors, a land of mists and shadows; but which, properly controlled by experience and reflection, becomes the noblest attribute of man; the source of poetic genius, the instrument of discovery in Science, without the aid of which Newton would never have invented fluxions, nor Davy decomposed the earths or the alkalies, nor would Columbus have found another continent."

Only one defect of classical instruction has been discussed. There are several others. The philosophical speculations of traditional Hellenism and the mechanical memorizing and formalism of medieval scholasticism have dominated educational schemes for centuries. Such a system of instruction has been tried and found wanting—it has masqueraded under the name of education. Let our educational aims be more worthy and appreciative of our glorious English literature, more adapted to human needs, and a study of Christian rather than pagan principles. The English language and literature, together with the arts and sciences (including mathematics) and the cultivation of a sound body, provide the basis of a complete and balanced education and a generous culture.

RHEOLOGY IN THE TEXTILE, LEATHER, SHOE AND ALLIED TRADES

AT a meeting of the British Rheologists' Club, held at Loughborough College on September 18, papers were read by Mr. A. Pollard, Dr. C. A. Maunder Foster, Mr. A. March, Mr. P. Danby and Mr. P. Stanley Briggs, and there was a discussion under the general title of "Rheology in the Textile, Leather, Shoe, and Allied Trades". It is convenient to deal with the proceedings in sections.

Textiles

In weaving, two banks of multiple warp threads are opened ('shedding'), a shuttle holding a single weft thread is passed through the 'shed' ('picking'), and a comb-like reed forces the weft into place ('beating'). The next 'shedding' operation locks the weft into place. Small inaccuracies in these three locating operations are, with staple material, partially corrected by the hairy projections from the yarn. With a smooth yarn such as rayon, which is solid rather than tubular, better location is needed; and the low 'tenacity' of the material calls for less alteration of stress than occurs in the normal 'broadcloth' loom.

In one modern ribbon loom, attention was given to these matters; warp tension was kept constant (the healds moving over the arc of a circle, centred at the line of the weft), the beating reed was given a very low amplitude, and all moving parts of the machine were very exactly controlled. Besides giving accurate and reproducible weaves, the output-rate of this machine is of the order of 1,000 'picks' per minute, or some 4–5 times normal speed of production.

A poor view was taken at the meeting of the engineering ability of many designers and builders of textile machinery in general. One assertion was made, that 'tenacity' of yarn (breaking strain in ounces per denier) does not necessarily measure its probable behaviour in weaving.

Shoemaking

Great use is made of stitching: upper construction; joining of lining to upper, of upper to insole of insole to welt, and of welt to outsole. Each o these operations is alike in outline; but as each uni process of the stitching differs according to th particular job, a whole range of machine designs, o awls, needles, shuttle threads, and of sewing threads is required.

For lubricant, the hand cobbler uses beeswax shuttle threads are waxed; sewing threads are rosined; and the material which, in the making operation, acts as lubricant, after cooling down seals the holes and preserves the threads.

In toe, and in heel, reinforcement is used. For this purpose the toe 'puff' may be shoddy cloth, sized with pitch or pyroxylin; or, for miners' boots, it may be steel. The toe-cap, puff reinforcement and lining must suffer the drafting strains of pulling on to a rigid wooden last; and thereafter must retain shape, and hold together as a unit.

The stiffener for the heel part is required to be rigid at its meridian, thin and flexible at its top edge.

After the shoe has been lasted, there is a hollow space under the middle of the insole; this mus be suitably filled with a composition having resilience before the outsole can be sewn or stuck on. Thus the foundation of the average shoe is a 'sandwich' of leather insole, cork composition or felt filler, and leather or rubber outsole. Should the filler be too soft, it will shift under the pressure of the foot, to give lumps and hollows in the insole surface which will be uncomfortable in wear.

Resilience, deformability, flexibility and the like are most often judged by the test of the trained finger-and-thumb. It would be desirable to have an artificial digital assembly, not subject to fatigue (or to prejudice), for these purposes.

In the operation of shoe-building, rubbery adhesives are largely used. The processes are repetitive mechanical, and output is very large (the standard figure for the United Kingdom is rather less than 100 million pairs annually).

The adhesive maker needs, therefore, to maintain a steady consistency in his products; and this task is not simple with some of the present-day materials For example, with a falling sphere viscometer, a thick paste of reclaim rubber solution may appea to have both thixotropic and dilatant properties. In a case such as this, trials were made, using a rotation viscometer, to obtain a consistent reading, so tha a method might be available for works use. Rotation times were taken with different loads, after various periods of stirring. Constant time for a single turn was attained in a typical experiment on a Störme instrument, after sixteen turns. Provided the load was above a certain lower limit (2 kgm.):

Load 2·1 kgm. after	1	2	4	8	16	32	turns
Time of single turn (sec.)	36	26	21	16	10	10	

Restoration of the system to the former high viscosity figure could not be completed: after 100 hours it was still slowly increasing, in linea fashion.

For measurements on this kind of stuff, the torsional viscometer was recommended as more suitable

Leather Finishes

The last treatment of leather, prior to sending to the warehouse, is to apply pigmented and dyed dressings or colourless seasons to the front surface (which is normally the grain side, but sometimes is the flesh side). The finishes used for this effect should have properties approximately the same as the surface layers of the leather to which they are bonded.

Some 50 per cent of the leather substance is animal protein in nature; the rest being added material of diverse origin. Animal protein likewise forms the main basis of leather finishes; with wax, shellac, pigment, grease and sulphated oil as the other ingredients, all dispersed in water.

So that the behaviour of the finishing materials under strains of the sort to which leather is subject might be studied, isolated films were stressed to the break-point. These films, between 10 μ and 15 μ thick, were cast on a rubber substratum, conditioned some days at 70 per cent relative humidity, and test pieces cut and stretched at a steady rate. Typical figures were:

	Casein	Shellac	Casein 4 : Shellac 1	Casein 4 : Wax 1	Casein 9 : Pigment 1
Elongation % at break	75	65	125	75	75

Casein plasticized with sulphated oil

	1%	2%	4%	8%
Elongation % at break	230	250	310	350

The optimum figure was got with 6 per cent plasticizer.

Several other forms of behaviour of leather finishes have to be controlled; partly in the formulation, and partly in the mode of application and after-treatment. These properties include gloss, hardness, colour, flexibility and 'feel'.

One of those present doubted the applicability of test results on continuous films; when the same material after application to the leather forms a largely discontinuous film. It was also asserted that pigment particle average size (say, 2 μ) is unimportant; the deciding (adverse) factor being the proportion and size of the larger aggregates of pigment. These, giving rise to marked localization of subsequent strains, might cause low adhesion and a brittle finish.

Leather Making

In the course of the conversion of raw animal hide into leather—soaking, liming, bating, tanning and so on—the aim is to control the closeness or openness of texture ('angle of weave'), the breakdown of reticular tissue, and the splitting (into 'fibrils') of the fibre-bundles.

Picturing the structure of leather as a trellis-work (in three rather than two dimensions), a closely-knit trellis, with high 'angle of weave', would be seen to present a compact collection of fibre-ends at the boundaries of the material. This was desirable where abrasion resistance is needed, as in sole-leather; and such a system is not readily deformable, and has elastic rebound. Close texture, coupled with considerable fibre splitting, would yield a somewhat more deformable material, as for example shoe upper leather.

In sole leather, the tannage is not pushed very far, and much filling material ('non-tans') incorporated; the grease content being small. In upper leather, the combined tan is higher, with less filler, and the texture internally lubricated with much grease. A tabular comparison is as follows:

	Sole leather	Upper leather	Belting leather
Angle of weave	high	high	low
Fibre splitting	slight	marked	marked
Tan %	18	24	24
Non-tan %	33	7	14
Grease %	3·5	17	11·5

These data related to vegetable tannage.

The chemical processes of the tannery, and the sundry mechanical treatments, can be so controlled that only one factor remains out of the tanner's reach. Until the animal can be so bred and reared as to produce a standardized pelt, this last factor would most likely continue to be an independent variable.

C. A. Maunder Foster.

MARINE BIOLOGICAL RESEARCH IN SOUTH AFRICA

The first of a series of pamphlets to be published by the Research Survey Committee of the Association of Scientific Workers of Southern Africa has recently appeared*. The work of the Committee is "intended to help in stimulating and developing research in the Union and in affording constructive suggestions for building up a more adequate and satisfactory organisation of research within the country". Dr. Wm. Edwyn Isaac, the writer of the present pamphlet, is on the staff of the Government Low Temperature Research Laboratory, where he has lately been working on problems of food technology and on South African seaweeds as sources of agar. He directs attention to the acute need in South Africa for basic research on marine problems and to the extreme shortage of laboratories and staff, giving excellent summaries under various headings: the fundamental cycle of life in the sea, knowledge of plankton basic to the fisheries, a brief history of fisheries research in the Union, our knowledge of chemistry and physics and of the marine biology of South African seas, certain general considerations arising out of the review of fisheries and marine biological investigations in South Africa, and, finally, a project for a marine research institute with special reference to plankton.

Marine products are among the least exploited of the Union's resources, although the fauna is a vastly rich one and there is abundance of fish. In 1934 the Board of Trade reported that the annual consumption of fish in the Union is only 4½ lb. per head of the population, and, later, C. von Bonde and Rees Davis directed attention (1942) to the small fish consumption. The corresponding values for Britain and Norway are 41 lb. and 70 lb. respectively. A sound knowledge of the marine biology and hydrology of the regions concerned is imperative, and at present only the fringe of such studies has been approached.

The project for a research institute with special reference to plankton is a good one, including as it does suggestions for special work at first conducted from one central research institution, later spreading to several marine stations with their full number of boats. It is urged that such a marine research institute should be concerned only with fundamental research, and although keeping in close touch with the fisheries should be freed from the routine of fisheries work. Although the desirability of a marine research institution is discussed more particularly in relation to plankton work, the author states that it is obvious that it would concern itself with all the fundamental aspects of marine biology. Work on the life-histories of the most important fishes is clearly one of fundamental significance, and it is to be hoped that it would occupy a large place in the planning of the work in the marine institute.

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* Marine Biological Research and the South African Fishing Industry. By Wm. Edwyn Isaac. Research Memorandum I, 1943. Published for the Association of Scientific Workers of Southern Africa (Cape Town Branch) by the African Bookman, P.O. Box 3115, Cape Town. 1*s.* 6*d.*

Sites for the central laboratory and for three substations are suggested. All these plans should not be too difficult to carry out in the near future, and although admittedly a background of fundamental knowledge can only be acquired by long years of patient work, the sooner this is begun the better. With such an unexplored field it is hopefully maintained that results of practical significance might emerge soon.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Saturday, October 30

Royal Anthropological Institute (at the Royal Society, Burlington House, Piccadilly, London, W.1).—Centenary Meeting.

At 11.15 a.m.—Sir John L. Myres: "A Century of Our Work".

At 3 p.m. (at 21 Bedford Square, London, W.C.1).—"The Future of Anthropology". (Dr. G. M. Morant: Physical Anthropology; Prof. V. G. Childe: Archæology: Mr. R. U. Sayce: Material Culture; Dr. R. Firth: Social Anthropology).

Monday, November 1

British Social Hygiene Council (in the Hastings Hall, B.M.A. House, Tavistock Square, London, W.C.1), at 3.30 p.m.—Sir Walter Langdon-Brown: "Social Biology and Planning".

Royal Institute of Chemistry (Yorkshire Section) (joint meeting with the Leeds University Chemical Society) (in the Chemistry Lecture Theatre, The University, Leeds), at 6.30 p.m.—Dr. A. D. Mitchell: "Demonstration of Improved Methods in Volumetric Analysis".

Tuesday, November 2

Society of Chemical Industry (Plastics Group) (joint meeting with the Institute of Plastics Industry and the Institution of Rubber Industry) (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 2 p.m.—Symposium on "Rubber-like Plastics and their Applications".

Royal Institution (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Sir Henry Dale, G.B.E., P.R.S.: "Progress in the Treatment of Infections", 1: "Assisting Nature's Reactions".*

Sheffield Metallurgical Association (at 198 West Street, Sheffield 1), at 6.30 p.m.—Discussion on "Hardenability" (to be opened by Mr. T. F. Russell, Dr. R. J. Sarjant and Dr. W. Steven).

Wednesday, November 3

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. E. F. Armstrong, F.R.S.: "The Long Road of Progress".

Geological Society of London (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Scientific Papers.

Institution of Electrical Engineers (Wireless Section) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. J. Kemp: "Wave Guides in Electrical Communication".

Thursday, November 4

Royal Institution (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir James Jeans, O.M., F.R.S.: "The Methods of Modern Astronomy", 1: "Spectroscopic Astronomy".*

Association of Austrian Engineers, Chemists and Scientific Workers in Great Britain (joint meeting with the Association of Austrian Doctors) (at Austria House, 28 Bryanston Square, London, W.1), at 7.15 p.m.—Dr. F. Scholl: "Chemotherapie im lichte neuer Forschungen—Sulphonamide und Penicillin".

Friday, November 5

National Smoke Abatement Society (at Caxton Hall, Westminster, London, S.W.1), at 10 a.m.—Conference on "Measures for the Prevention of Smoke in relation to Plans for Post-War Reconstruction".

Society of Chemical Industry (Yorkshire Section) (at the Queen's Hotel, Leeds), at 3.30 p.m.—Dr. Wm. Cullen: The First Brotherton Memorial Lecture.

Physical Society (in the Physics Department of the Imperial College, Imperial Institute Road, South Kensington, London, S.W.7), at 4.30 p.m.—Dr. Bruce Chalmers: "The Non-destructive Testing of Metallic Components."

Royal Institution (at 21 Albemarle Street, London, W.1), at 5 p.m.—Dr. A. O. Rankine, F.R.S.: "The Dispersal of Fog".

Saturday, November 6

Nutrition Society (at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1).—Conference on "Post-War Nutritional Relief".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Lecturer in Mechanical Engineering—The Principal, Technica College, Brunswick Road, Gloucester (November 4).

Borough Electrical Engineer and Manager—The Town Clerk Town Hall, Leigh, Lancs. (endorsed 'Borough Electrical Engineer and Manager') (November 4).

Cultivations Officer to the Isle of Wight War Agricultura Executive Committee—The Executive Officer, Lugley House Lugley Street, Newport, Isle of Wight (November 6).

Specialist Teacher for the Remedial Treatment of Stammering—The Director of Education, Education Offices, Burnley (November 6).

Teacher of Mechanical Engineering Subjects—The Principal, Luton Technical College, Park Square, Luton (November 9).

Borough Engineer and Surveyor and Water Engineer—The Town Clerk, Town Clerk's Office, Brook House, Dover (endorsed 'Borough Surveyor') (November 15).

Head of the Electrical Engineering Department—The Secretary, Robert Gordon's Technical College, Aberdeen (November 20).

Forest Engineer, and an Assistant Forest Engineer (must be good mechanical engineers with experience in sawmilling, steam engines and mechanical logging operations), for the Sierra Leone Forestry Department—The Secretary, Overseas Manpower Committee (Reference No. 1114), Ministry of Labour and National Service Alexandra House, Kingsway, London, W.C.2.

Teacher of Mathematics and Mechanics—The Principal, Erith Technical College and Day Technical School, Belvedere, Kent.

Mechanical and Electrical Engineers (2) with (a) ability to stimulate and supervise local production in ferro-alloys, carbide detinning, electrodes, etc., and be familiar with metallurgical work, and (b) conversant with foundry and metal work and construction—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.1910A).

First Assistant Engineer (Reference No. E.776), and a Second Assistant Engineer (Reference No. E.777)—The Ministry of Labour and National Service, Central (Technical and Scientific) Register Alexandra House, Kingsway, London, W.C.2 (quoting the appropriate Reference No.).

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Scottish Society for Research in Plant-Breeding. Report (abridged) by the Directors and Report by the Director of Research to the Annual General Meeting, 15th July 1943. Pp. 34. (Edinburgh: Scottish Society for Research in Plant-Breeding.) [22

Edinburgh and East of Scotland College of Agriculture. Calenda for 1943–1944. Pp. 62. (Edinburgh: Edinburgh and East of Scotland College of Agriculture.) [24

A Glossary of Terms used in Sex Hormone Therapy. (Reprinted from the *Pharmaceutical Journal.*) Pp. 20. (London: Pharmaceutical Press.) 1*s*. [27

National Central Library. 26th and 27th Annual Reports of th Executive Committee, 1941–42 and 1942–43. Pp. 24. (London National Central Library.) [27

Other Countries

Smithsonian Miscellaneous Collections. Vol. 104, No. 1: The Feeding Apparatus of Biting and Disease-Carrying Flies; a Wartim Contribution to Medical Entomology. By R. E. Snodgrass. (Publication 3732.) Pp. ii+51. (Washington, D.C.: Smithsonian Institution.) [10

Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditures and Condition of th Institution for the Year ended June 30, 1941. (Publication 3651. Pp. xiii+596+121 plates. (Washington, D.C.: Government Printin Office.) 2 dollars. [20

Newfoundland Government. Research Bulletin No. 12: Salmo Investigations, 1: Obstructions in Newfoundland and Labrador Rivers. By A. A. Blair. Pp. 50. (St. John's, Newfoundland: Department of Natural Resources.) [21

Arkiv för Zoologi utgivet av K. Svenska Vetenskapsakademien Band 34A, No. 13: Entomological Results from the Swedish Expedition 1934 to Burma and British India. Lepidoptera: Drepanidae Meyrick, gesammelt von René Malaise. Von Felix Bryk. Pp. 30+ plates. Band 34A, No. 20: Further Contributions towards the Comparative Morphology of the Mesostigmata (Acarina), 6: The Antennophoridae and the Megisthanidae. By Ivar Trägårdh. Pp. 10. (Stockholm: Almquist and Wiksell.) [21

College of Science
Physics Dept.

NATURE

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EDUCATIONAL RECONSTRUCTION (5)

Compulsory Part-time Education

THE Government's White Paper on Educational Reconstruction is headed by a, well-known quotation : "Upon the education of the people of this country the fate of this country depends". That, of course, is profoundly true. It states the broad problem of the future in undeniable fashion. But it has been also significantly underlined by the Prime Minister when he said : "The future of the world is to the highly educated races who alone can handle the scientific apparatus necessary for pre-eminence in peace or survival in war". Implicit in that statement is the need to know what *kind* of education we are to provide for those who are to follow us.

The White Paper is necessarily concerned with the machinery rather than the content of education. But the structure of the machinery is obviously not without its indications of content possibilities, since it at least shows us something of the scope of education which the machinery will permit.

Consider the proposals for compulsory part-time education, since the main criticism of our present full-time education arrangements is directed at this aspect. Full-time education ceases about the age of fourteen. What does that mean to us if we are really considering education as something upon which the fate of Great Britain—and that means the fate of the children of this country—depends ? Sir Richard Livingstone has summed up its meaning in one vivid phrase : "To cease to be educated at 14 is as unnatural as to die at 14". But in case the phrase be open to any quibble at all, let us use an equally vivid and descriptive phrase which occurs in the White Paper itself. If the effects of education carried on only to the age of fourteen are thin and liable to wear off quickly in the rough and tumble of the industrial and commercial world, the language of photography provides us with the reason. "The process of education for the vast majority of children", says the White Paper, "offers at present an example of 'under-exposure, under-development and insufficient fixing'."

Something has to be done then to remedy the defect, and the first step is to raise the school leaving age to fifteen and, later, to sixteen. But even that is not enough. The full value of raising the school leaving age will not be secured unless the results are consolidated. How is that consolidation to be secured ? There must, says the White Paper, be continued supervision of the health of young people after full-time schooling has ceased, and opportunity must be provided to develop their capacities and interests. The present War very quickly showed us that if the provisions for day continuation schools in the Education Act of 1918 had been operated, many of our present problems would not have arisen.

The White Paper therefore makes it clear that "all young persons from 15 to 18 will be required to attend an appropriate centre part-time, unless they are in full-time attendance at School or otherwise under suitable part-time instruction". The attendance will be taken from hours of employment and, at first at any rate, will be limited to a day per week or its equivalent. Moreover, we are glad to note that the old title of 'day continuation school' is to be abandoned, and 'young people's colleges' substituted. That, indeed, is not the best title, but it is better than a title which might indicate that what is to be done is a mere extension of previous schooling. The point to be emphasized is that a new phase of life and development is to begin.

We need not enter here into details of variations of a general plan which may have to be made. The rural areas present problems which will have to be resolved. So also do the cases of young persons serving at sea. But these matters are noted and recognized by the White Paper and will, we hope, be brought within the scope of the new proposals without excessive difficulty.

Already we have pointed out that the proposals for this new machinery give indications of the scope and content upon which interest and thought must be concentrated. The indications are clear so far as the young people's colleges are concerned. The young people concerned will be engaged in a variety of occupations. For all of them, however, there are basic elements which must be included in their training. Thus "provision must be made for their well-being through physical training and remedial exercises and instruction in health and hygiene. The school medical service will be extended to cover them. . . . Other essential elements will be training in clarity of expression and in the understanding of the written and the spoken word, together with some education in the broad meaning of citizenship to give some understanding of the working of government and the responsibilities of citizens and some interest in the affairs of the world around them".

If that be achieved, we believe a prime move will have been made to produce people who can "handle the scientific apparatus necessary for pre-eminence in peace or survival in war".

Technical, Commercial and Art Education

We turn now to the proposals for "Technical, Commercial and Art Education", and here we note one of the two major issues to which the White Paper directs attention: the need for the further development of these branches of education.

That need has been heavily underlined by the War. We know now how vital a contribution has been made to the war effort by the technical colleges. They have, to put the matter quite mildly, not only trained munition workers and members of the Forces; they have also worked miracles as production centres. The White Paper recognizes their contribution. They have "made a contribution to the specialized training of the personnel . . . the value of which cannot be over-rated . . . they have shown, notwithstanding the handicaps imposed by war conditions, that they can assist in effective training to a degree and in a way, the possibilities of which industry has not hitherto generally appreciated". Vast developmen in industry and commerce are now envisaged, an we have in these columns already indicated the nee which will exist for special training. It is well, ther fore, to note that the White Paper suggests tha "industry and commerce should review their arrang ments for training, and should co-operate in ass ciating the technical colleges and art schools mor fully with the industrial and commercial life of th country".

Our present system—and the White Paper inte polates the remark "if it can be called a system" will clearly be insufficient and inadequate to the cal the future will make. We note, for example, tha at present the provision of further education is power and not a duty of the local education authoriti and technical education has not advanced in conce with the needs of a highly industrialized communit We note, too, that "in particular the standards the buildings and equipment in use have often bee deplorably low, and comparison with what can seen in other countries which have been our co petitors in the world markets, can leave little cau for satisfaction". In pre-war days a programme f the provision of colleges and the expansion a bringing up to date where necessary of others alrea in existence had been made, and for that purpo capital expenditure of some £12,000,000 was co templated.

The White Paper indicates that this is to remedied. The cost will be considerable. That recognized: "The post-war cost of such a programm will inevitably be higher [than the £12,000,000], b it will be of the first importance that these pla should be revised and expanded to meet the ne requirements, and, as soon as possible, carried in effect". With that in mind provision will be made place a duty on education authorities to provi adequate facilities for technical, commercial, and a education, both full-time and part-time.

So far, so good. In general the White Paper's pr posals must be regarded as satisfactory up to th point. But it is here we must turn to the append to the White Paper which deals with the financi implications of all the proposals. We are warn that "it is not proposed to introduce any of t proposals until after the war". Thereafter there is plan which will occupy some four years, and "t development of technical and adult education is n included among the matters to be dealt with in t first four year plan". Nevertheless "some allowan has been made for preliminary expenditure in resp of technical education".

How much? The allowance for "preliminary e penditure" is to be made two years after the Wh Paper scheme begins to operate, and it will form o 1·11 per cent of the total educational expenditu In the succeeding years this percentage falls to 0 per cent, and then, in successive years, beco 0·58, 1·21, 2·45 and 2·98 per cent. Thus, seven ye after reconstruction has begun, less than 3 per ce of educational expenditure is concerned with te nical education.

The Parliamentary Secretary to the Board ducation, in a recent debate, said that the figures present the capital charges on new buildings. We onder what new buildings are to be secured for an xpenditure of these dimensions. And, in the meanme, what is to happen about the equipment which so early must be provided ? What estimates are enisaged to secure the greatly increased recruitment f the highly qualified and experienced teaching staff hich will be necessary ?

We can provide no answers to these questions. We cord, as of course anyone must record if the need r educational reconstruction be clearly known and ppreciated, our admiration of the broad sweep and aracter of the proposals which the White Paper as adumbrated. But we cannot help expressing the ar that, if so much time must elapse after the War efore the real and concrete work of educational construction can begin, there will be a very clear anger that the high hopes the educational proposals ave raised may very easily be disappointed. We not pretend to ignore the difficulties. Of course ere will be difficulties. No one knows when the ar will end. There will be many things to be done hen it does end ; things which will be called priorities d which indeed will be noble and inescapable iorities. But when we talk of technical education e believe we talk of something which is inextricably nked with the welfare and success of that vital dustry and commerce upon which will rest the ssibilities of so many of the social improvements e country expects. There must then be no lapse time in reforming our present system so that it ay meet the demands which will be thrust upon it.

We hope, then, that the Government will review time-table of educational reconstruction and give vift and real meaning to the proposals we have ted and long to see put into effect.

THE FUTURE OF TECHNICAL COLLEGES

HE correspondence which has been proceeding in the columns of NATURE under the heading he Future of Technical Colleges" is both timely d important. Recent publications, such as the hite Paper on Educational Reconstruction, and e still more recent report of the Parliamentary d Scientific Committee on "Universities and Rearch", show a growing awareness of the fact that Great Britain is not to be overwhelmed by the ing tide of science, it will be necessary to mobilize the scientific and technical ability the country n muster. We shall need all the pure scientists can discover, a far greater number of first-class chnologists, and an innumerable host of skilled chnicians. In the education and training of this my of reconstruction, both the universities and the chnical colleges must play a part, and the task is, ite frankly, beyond their present resources. Before blic money is spent, as it must be, on increasing ose resources, it is clearly desirable, in the interests economy of both money and man-power, that the respective functions of the universities and the technical colleges shall be clearly defined, and each of them equipped for their appropriate functions.

It is unfortunate that a single rather emphatically worded sentence in Dr. Lowery's letter in NATURE of August 21 should have been construed as an attack on the quality of the instruction given in the technical colleges of Great Britain, since the volume and vigour of the quite natural reaction has rather swept the discussion from its most fruitful channels, and has caused the many admirable suggestions made in that letter to fall somewhat into the background. No one would question that, in days when universities were few and university scholarships both hard to come by and inadequate in amount, technical colleges performed a valuable service by stepping into the breach, and enabling men of high ability, who through lack of funds were unable to obtain the university education which their talents would have justified, to establish themselves in the scientific world by means of an external degree. The system whereby such men should have to depend for their education on the classes available in the local technical colleges, often after the end of a full day's toil, cannot be regarded as more than a temporary expedient. It no longer satisfies either the social conscience or the urgent needs of the times. As the White Paper states, "high ability should not be handicapped by accidents of place of residence or lack of means in securing a University education". Courses in technical colleges, however efficient the instruction and equipment, do not constitute a university education ; nor can the matter be entirely rectified by affixing the stamp of an external degree to the product. The fact that in some of the larger cities of Great Britain a university and a technical college may be found flourishing side by side, shows that the two types of education are not felt to be identical (City Fathers are not usually guilty of extravagance in matters of education) and that in a complete educational system each is needed to supplement the other.

It is important that this duality of function should not be overlooked in planning the reorganization and extension of higher education. It is an expression of a similar duality in human interests : on one hand, the desire to understand; on the other, the desire to construct. Each is essential to human progress. Each requires its appropriate type of training. The primary function of a university is the conservation and extension of learning, and the training of men and women who shall carry on this tradition. Every university department is, or ought to be, a research department, and it is for this reason, rather than for any supposed superiority in equipment or standard of teaching, that it is important that students whose interests and aptitudes mark them out as the research workers of the future should receive their education within a university.

From a utilitarian point of view—there are, of course, others—the importance of such students lies in the fact that the science of to-day becomes the industry of to-morrow. Relative to the large number of technicians and technologists who will be required to staff our industries, their numbers will probably always be small. As Sir Lawrence Bragg has pointed out, the output of first-class physicists, for example, is only about one per annum per million of the population. Our survival as a great industrial nation may well depend on doubling our production of university graduates in pure and applied science.

For the training of the great army of technicians which modern industry demands, we must look, not to the universities but to the parallel branch of education which is represented at present mainly by the technical colleges, and for two reasons. In the first place, many capable technically minded students find the wide range and strict mental discipline of a university course both difficult and distasteful. In the second place, the power of a university to fulfil its own special function in the community depends on an equal and harmonious development of all its faculties. A wholly disproportionate growth of the technological faculties would so seriously impair the fabric that the institution would almost cease to function as a university at all.

The arguments which have led the Norwood Committee to recommend the division of secondary education into academic (grammar school) and technical apply with equal force in the sphere of higher education. As the students from the grammar schools look to the universities for their further education, there should be technical colleges of similar status to which the student from the technical secondary schools can look for further training. Few of the existing technical colleges of Great Britain, handicapped as they are by the necessity of providing an immense number of courses for students of the most elementary type, can be said adequately to satisfy these requirements. What is needed, as Messrs. Barber and Andrews have already urged in their letter in NATURE of October 2, is the development and adequate endowment of a sufficient number of institutes of technology, corresponding to the Technische Hochschulen of the Continental system, capable of playing the part in technical education which the universities fulfil in pure and applied science and the humanities. Such institutions would need no stamp from an external university to guarantee their students. Their existence would give a new status to technical education as a whole.

The relations between these new colleges, the local technical colleges and the applied science departments of the universities, clearly call for much thought and mutual consultation, if wasteful overlapping of functions is to be avoided. So also, as has already been pointed out in the leading article in NATURE of October 16, does the method of apportioning the students to the most appropriate institution. The Board of Education, as guardian of the technical colleges, might well initiate such consultations. The Government is being pressed, and rightly so, for large capital grants both for university and for technical education. It is important that their relative functions shall be wisely decided before the money is spent. The opportunity of obtaining an adequate and well-balanced system suited to the needs of the times will not soon recur.

TECHNIQUE OF BLOOD GROUPING

Blood Grouping Technic

A Manual for Clinicians, Serologists, Anthropologist and Students of Legal and Military Medicine. B Dr. Fritz Schiff and Prof. William C. Boyd. Pp. xiv 248. (New York: Interscience Publishers, Inc. London: Imperia Book Co. Ltd., 1942.) 5 dollar

DR. BOYD in the preface to this book state "Some years ago Dr. Schiff approached n with the proposal to assist him in getting out a up-to-date book on blood grouping technic, somewh on the lines of his well-known book in German (Die Technik der Blutgruppenuntersuchung)". A English version of this Continental classic, r vised and brought up to date, would always b welcome.

The translation of the senior author's script l Dr. Boyd has been masterly. With its concise, cle and straightforward sentences, this book is a mod of modern English style. The title describes it as manual for clinicians, serologists and anthropologist who will welcome it for the wealth of its content Students and tyros in serology will likewise welcon the book for the clarity of the presentation of th material.

Chapters 1 and 2 on the theoretical foundatio and general technique of blood group determinati give a brief but comprehensive survey of the subjec The methods considered in Great Britain to be th most reliable are strongly recommended by th authors, who at all times stress rightly the need f adequate controls to all group determination. Th *A*,*B*,*O*, *M*,*N*, and *P* factors are all well and fully dea with. The *Rh* factor is described briefly and the light of modern knowledge rather inadequatel (This is accountable for by the fact that the bo was published in 1942 and therefore probably writt in 1941.) Only the earliest work of Landsteiner a Wiener and of Levine, Katzin, Vogel and Burnha is quoted.

Chapter 3 describes the application of blo grouping techniques. First, there is the applicati to blood transfusion. Careful grouping of bo donor and recipient and equally careful cros matching are constantly stressed. The choice of donor—friend, volunteer or professional—is discusse and the regulations governing blood donors and blo banks in New York City are quoted. The secti on blood and plasma banks might well have be omitted or alternatively elaborated.

Secondly, the problems of relationship, includi disputed paternity, are discussed *in extenso*. Th authors insist that, although the principle of th procedures can be understood by all, the actual tes should be entrusted only to experts. An expert defined as a person, with adequate scientific trainin such as is symbolized by the degree of Ph.D., Sc.I M.D., or equivalents, who for a number of yea has been carrying out blood grouping tests and co ducting research in serology as applied to blo groups, and the emphasis is placed on the resear worker rather than the routine hæmatologist as th expert of choice.

Thirdly, other forensic applications are co sidered. The identification of blood stains is al regarded as a procedure only to be undertaken l those with experience in the techniques involve These are fully described. The methods of testi gans, secretions, and body fluids other than blood, e also noted.

Fourthly, an account of the related factors, includ g the Forssman antigen, in animals is given.

Finally, blood group investigations in anthropology e described. "Blood group determinations are aracteristics genetically determined, by a known echanism, absolutely objective in character, abso tely unaffected by environment, not subject to utation at any rapid rate, and, so far as we are able discover by extensive investigation, non-adaptive. it is possible to discover anything about the course human evolution by classifying mankind, the most eful data should be the blood groups". This titude of the author (or authors) is the keynote an interesting section. Once again a reliable chnique and a careful evaluation of results are nphasized. Methods of examining archæological aterial, mummified tissues and bones, are also ven.

Forty-five figures and sixty-seven tables are cluded in the book. On the whole they clearly ustrate the text, though in a few instances diagrams e presented with little accompanying explanation, hich may be confusing to the uninitiated.

The number of references to the literature, it is aimed, has been reduced to a minimum, but the imber will be adequate for most readers.

JOHN F. LOUTIT.

FOREIGN TRADE AND TARIFFS

ade Regulations and Commercial Policy of the United Kingdom

y the Research Staff of the National Institute of conomic and Social Research. (National Institute of conomic and Social Research, Economic and Social udies No. 3.) Pp. x+275. (Cambridge: At the niversity Press, 1943.) 15*s.* net.

THIS book is a portion of the British contribution to a study of international trade regulations and mmercial policy which was initiated at Geneva in 38, and which was designed to give a comprehensive cture of the major changes in the methods of control world trade since the conclusion of the War of 14–18. The outbreak of the present War has terfered with the completion of the project as iginally conceived; but it has been thought sirable to publish the descriptive material now, aving certain statistical studies and consideration the economic issues along with an examination of e changing international economic position of the nited Kingdom for discussion in a later volume. is was undoubtedly a wise decision; for in the esent work we have, as the chairman of the Council Management of the National Institute of Economic d Social Research remarks in his preface, a tech cal descriptive study which provides a convenient d more detailed picture than has hitherto been ailable of the development of British commercial licy, and particularly of Protectionism in all its rms, up to the end of 1938.

What has happened since then will cause more ofound changes in Britain's future economic posi n in the world than even the booms and slumps and cks and experiments of the 1930's. This is well t for future study.

It is not to be expected that a work of this kind, onsored by a committee and finally revised by one its members, would be much more than an objective and an accurate account of Acts of Parliament, commercial treaties, statutory rules and orders and the like. Even if it were only this, a very great debt of gratitude would be due to the National Institute for getting so much into so convenient a compass. But the book is something more than a catalogue, and the reader who wishes, to take one example, to study the course of Imperial Preference, will find much to help him in addition to the mere enumeration of negotiations embarked on and agreements concluded. It is, however, strictly limited in scope and its plan requires it to omit an account of the background prior to 1914 against which its contents have always to be pictured.

Many of the difficulties in trade encountered in the 1930's can be traced to origins back in the free trade period just after the middle of the nineteenth century. It was then that the Dominions imposed tariffs and began to build up infant industries which drove out home products from the Colonial markets. Soon, they claimed complete economic autonomy, and after the War of 1914–18 they assumed, in due course, all the powers of independent States. At Ottawa in 1932 they succeeded in inducing the United Kingdom to adopt a policy of tariff exclusiveness and thus laid the foundations of what was hoped would become an imperial economic unity. In all this they took the initiative, and the measures they advocated were directed primarily to secure their own economic interests rather than those of the mother country. Perhaps, as events have turned out, this was not altogether a bad thing. But the present War will leave them (certainly some but, possibly, not all) still stronger as against the United Kingdom than they were in 1938. Dominion status, in consequence, may require a new Statute of Westminster to deal with a greatly altered situation, and considerations other than economic ones will probably assume major importance in the settlement that will then ensue.

But these changes in the mutual economic relations between the component parts of the British Empire were part of a development which was widespread throughout the world. A period in which raw materials and semi-finished goods of foreign origin were imported and worked up to be exported as finished goods to other countries was being superseded by a period characterized by the exchange of manufactured goods for manufactured goods, in which the international movement of raw materials tends to fall and every country to work up its own resources. British politicians and economists were slow in recognizing this trend, and one of the latter could write in 1914 that so far as he could foresee "a large interchange between countries of foodstuffs and raw materials against manufactured goods is destined to continue for an indefinite time to come". The War of 1914–18 stimulated the movement, and in 1925 the Balfour Committee on Industry and Trade was able to diagnose the situation correctly in its "Survey of Overseas Markets". By 1938, taking Japan, Canada and Italy as examples of industrially young countries creating their own national industries, the volume of the international trade of these countries with one another and the rest of the world was much below that of 1929. This is true, also, of other countries industrially older, and particularly of Russia. Indeed, it was the industrialization of Russia, depriving Germany of raw materials and of a market for the sale of finished products, which caused Hitler, as many passages in "Mein Kampf" testify, to look to that country as a source of supply at any cost for Germany of materials not found in sufficient quantities at home—materials to be obtained by force when trading methods failed.

That the United Kingdom experienced similar difficulties is demonstrated by the detailed story of tariff-making as set out in the volume before us. What lessons can planners and reconstructors learn from this ? Are they to assume that the tide will continue to flow in the direction it took in the 1900's and maintained so strongly in the 1930's ? If so, then they ought to aim at what is called a 'balanced' agriculture, at production of high-quality goods by skilled craftsmen, at the development of small-scale rural industries, at wide diffusion of ownership of capital, land and houses, at anti-trust legislation and the like. But if they conclude that the trend has run its course (and there are some grounds for this belief) then public ownership and control of large-scale industry with the State alone engaging in international trade might well be the policy to pursue. The choice is not an easy one to make. It is disquieting that the most vocal of the planners seem unaware that choosing is a necessary preliminary of action.

J. G. SMITH.

THE BIBLE EXAMINED

In Search of the Real Bible

By A. D. Howell Smith. (Thinker's Library, No. 98.) Pp. v+120. (London: Watts and Co., Ltd., 1943.) 2*s*. net.

TO the question, What is the real Bible ?, the answer is that it resembles an ancient city site where many cultural strata exist one below the other. If the archæologist digs deeply, he will discover some very primitive remains, while nearer the surface lies more recent, and perhaps more advanced, material. Thus Mr. Howell Smith has no difficulty in unearthing some primitive and, to us, unpleasing elements in the Bible—deceptions, obscenities, and barbarities of various kinds. This should shock none but the Fundamentalist, who cherishes a preconceived and untenable idea about the Bible ; the well-informed man knows that all primitive literatures display parallel traits. It is equally easy to show that the biblical cosmology and science are no longer tenable ; though it would be an error to imagine that only one cosmology exists in the Bible. Of the Deity, varying conceptions are present in the Bible, as Mr. Howell Smith shows, and as one would expect from this fairly complete record of a development of religious ideas, which is what the Bible is.

Mr. Howell Smith supplies the reader with a clear and quite fair summary of the results of what is known as the Higher Criticism. He is inclined to overstress the divergences of opinion among scholars, who are pretty well agreed as to "the approximate dating, mode of composition, and historical value of the different books". Only the mentally indolent will be "bewildered" or reduced to believing "that perhaps the Fundamentalists are right in dismissing all biblical criticism as a mass of arbitrary speculations". For this reason it is to be regretted that Mr. Howell Smith did not include a brief description of the methods of the biblical critics, which are indeed very simple. There is nothing abstruse or recondite about them.

Mr. Howell Smith pays tribute to the high cultural value of some parts of the Bible. "The Canon of the Hebrew Prophets contains some of the most exalted literature mankind has produced, and many of its pages are afire with hatred of oppression and injustice". *Job* is "one of the greatest literary achievements in the world". *Ruth* is "a charming tale of loyalty and kindness". *Jonah* teaches "lessons of mercy and forgiveness". With regard to the last book, it might have been added that here alone in the Bible is displayed a delicate sense o humour.

Not the least interesting chapter of the book, "The Spade and the Critic", discusses the bearing of recen archæological discovery on the historicity of the events recorded in the Bible, and upon our knowledge as to the sources whence certain biblical ideas were derived. Perhaps most students will agree with Mr. Howell Smith that Sir Charles Marston's recen attempts to make the stones of Egypt and Mesopotamia refute the critics have not been very successful.

Of course one's estimate of the value of the Bible will depend very much upon the estimate one hold of the value of religion as an element in human culture. Mr. Howell Smith would not appear to place that value very high ; and this necessarily involves a certain lack of sympathy with his subject But apart from this defect, Mr. Howell Smith ha written an informative little book.

J. C. HARDWICK.

AGRICULTURAL CROPS OF THE UNITED STATES

Field Crops

By Prof. Howard C. Rather. (McGraw-Hill Publications in the Agricultural Sciences.) Pp. ix+454 (New York : McGraw-Hill Book Co., Inc. ; London McGraw-Hill Publishing Co., Ltd., 1942.) 26*s*.

THIS book sets out to describe the general principles underlying the cultivation of the principa agricultural crops grown in the United States, in form suitable for first-year students in agricultural colleges. The book covers the principal America crops very evenly. It includes pasture and meadow management and the growing of leys and forag crops, particularly leguminous ones, with their attendant problems of grazing control, hay- and silage making and seed-production. The cereals and pulse grain crops, and the typical American crops o maize, tobacco and cotton, are naturally dealt with but potatoes and sugar beet are the only root crops discussed, the typical British root crops—mangolds swedes, turnips and kale—not being mentioned.

The text is always clear and straightforward, and well supplied with actual examples, tables, figure and illustrations. The great difficulty of the subjec is that the general principles underlying the variations in the actual methods of growing a particular crop over an area the size of the United States are sti only imperfectly understood, and this difficulty is reflected in the book ; for the general principles ar often only implicit in the text, so that a student unfamiliar with the conditions in the various State will sometimes have difficulty in appreciating the factors controlling the cultivations used. The value of the book is that it contains in one volume materia that is either only obtainable in encyclopædias and in a mass of separate bulletins, or else is only cursorily dealt with in the elementary agricultural books

E. W. R.

A TECHNOLOGIST LOOKS AT THE FUTURE

THE address delivered by Dr. C. R. Burch on the occasion of the presentation to him on pril 9 of the nineteenth Duddell Medal of the hysical Society took the form of an outline account certain advances in physical technology in which e has taken part, set out with the view of demon- rating some of the circumstances and conditions hich made those developments possible.

"These may perhaps illustrate the kind of conditions at we have to establish in the future, if we want ood technological progress to be made in Great Britain. nd it is vitally important that we should stand in the chnical forefront—at least as important in the com- g peace as in the war. Here is something we can- ot afford to neglect: whether we like it or not, hether the politicians like it or not, technical pro- ess, more than any other controllable factor, is shaping our brave new world. We have to produce contribution at least as constructive as that of our llies: if we fail in that, we shall not keep their spect, and if we do not keep their respect we shall rtainly lose their alliance."

Dr. Burch's story opened about twenty years ago, Metropolitan-Vickers, when Dr. T. E. Allibone as working on the preparation of zirconium as the asis of a long-term programme devised by Dr. . P. M. Fleming. Zirconium was known in powder rm, and the investigation aimed at producing it in herent metallic form, with the view of examining s properties. The question of industrial use was a m prospect; the immediate task was to gather owledge. It was decided to try the induction rnace, and it proved successful; but so far as uld be seen at the time, neither the metal itself r alloys of it were of any commercial value. Never- eless, the effort had not been wasted time, for it d produced a team of three men, Allibone, Burch d Ryland Davis, who had gained considerable owledge and experience of vacuum work, high- equency technique and the application of H.F. cur- nts and induction heating, together with "some- ing of the artist's sense of enjoyment, emotional ive, call it what you will, that arises from widening e range of one's experimental inquiry".

Ryland Davis and Burch continued with the de- lopment of induction furnaces, leading to a $\frac{1}{4}$-ton rnace which would melt brass or copper at 50 cycles steel at 500 cycles in place of the million cycles cessary in their earlier furnaces.

"The coil for this furnace was about the size of small dustbin—a coil of one layer of 1 in. × $\frac{3}{16}$ in. pper strap, wound on 'high edge'; 130 turns of in a length of 24 in. or so. It had to be water- oled on the outer edge of each turn, so as to leave radial thickness of 1 in. of solid copper on the side of the coil. The Transformer Department ound the coil for us. But we had to tackle the water- oling ourselves. This we did by adapting a device lled a 'mica undercutter' to mill a semicircular oove round the outside of the coil, and in the groove e soldered sixty lengths of $\frac{1}{8}$ in. copper tube—a tal of about 200 yards of it, providing sixty separate lets and outlets so that enough cooling water could got through the coil to remove the 30 kW. resist- ce-loss that occurred in it, when it was used on ass, or the rather smaller loss which occurs in it hen it is used on steel. I should like to record our thanks to Mr. Hutchinson, now of Sir George Thomson's staff, who helped us solder that interminable joint. I do not say that coil was a thing of beauty. But it did its two-fold job. Here may I touch once more on the future?

"Let us do all in our power to make it possible for the embryo physicist of the future to satisfy fully any desire he may have to acquire knowledge of crafts and skill in the use of tools. I cannot assess too highly in this respect the education I received at Oundle School. I use deliberately the phrase 'education' in the use of tools rather than 'training' because again and again I have been struck by the extent to which such craftsmanship and manual skill as I possess has helped me to form happy personal relations rapidly with all sorts and conditions of men. As that is an extremely important part of life, I am not going to apologize for digressing into a brief analysis of the operative factors. On the conscious level, the existence of a common manual skill or craftsmanship provides a link of mutual respect, and mutual respect is almost invariably an essential prerequisite to friendship. On the unconscious, or as some psychologists prefer, unwitting levels, the acquisition of a similar craftsmanship provides a number of similar links between ideas, and, what is far more important, similar links between ideas and emotions, so that similar emotions are the more readily aroused, and similar ideas the more readily 'intuited'—in short, the two men are the more readily in sympathy. Of course, if the skill has been acquired reluctantly under compulsion, any related idea is the more likely to arouse the emotion of hostility, and the idea of hostility, and even, at a higher level of mental integration, something far worse—the ideal of hostility. For that reason I would not for one moment advocate imposing in the sacred name of education compulsory courses in workshop practice for all and sundry, or even for all physicists. No! That isn't my 'ideal' at all. Rather would I see courses of this type run simply for such as care to attend.

"I should like to touch on two other aspects of the value of work with one's own hands. First, in design: in my experience it has only been physicists who do not make their own apparatus who have been apt to persist in designing things that are quite incredibly difficult and expensive to make—difficult out of all proportion to the very small gain associated with the design in question. When you explain this to them, they see the point, and not without a certain bitterness do they complain that they must keep a conscious and exhausting watch for pitfalls of construction which those 'educated' in the use of tools very largely avoid as it were unconsciously and reflexly, by sympathy."

The 500-cycle $\frac{1}{4}$-ton steel furnace being made, it had to be shown that it could be used to make alloy steels. In the face of the scepticism of practical steel-makers, the difficulties of 'teeming' the molten steel were overcome, and the 'electric fountain' effect, due to the magnetic field of the coil acting on the eddy currents in the molten charge and causing the metal to well up in the centre and run down at the sides, was found not to distribute small particles of slag through the metal. All this took more than a year to accomplish, and useful information on 'chilling' and 'burning' of cast metal was obtained.

Dr. Burch emphasized here that although Ryland Davis and he made part of the first $\frac{1}{4}$-ton furnace with their own hands, and supplied in some measure inspiration and technical leadership, the development, even at this stage, had only been possible by the co-operation of many others in the Research Department and in other parts of Metropolitan-Vickers. By 1934 there was installed in Sheffield a total induction-furnace capacity of 13 tons of furnaces capable of simultaneous running, and 6,000 kW. of generators. By 1939 this had risen to 38 tons and 16,000 kW. of generators. As the power consumption is about 600 kWh. per ton, this means that in 1939 Sheffield could turn out 600 tons per day of induction furnace steel.

"Thus the part played by Ryland Davis and myself, building on the foundations laid by Northrup and others, is itself already in some sense out of date, and is but another foundation on which a younger generation is building; and that, some say, that transitory and ephemeral aspect of technological achievement, is just what deprives it of cultural value or spiritual satisfaction. I cannot agree with that view at all. For it is the special glory of our science and its applications that the more it changes, the more it is the same thing. I am sure that all who have taken part in any technological development will have found as a concomitant of achievement a fuller realization of the underlying unity of past and present, and a lasting satisfaction of the kind that can endow even tragedy with triumph. These are matters not capable of precise definition, but expressible only in terms of mysticism and of poetry. When the subject is technology, one turns naturally to Kipling—may I remind you of his poem 'The Palace', in 'The Five Nations'?"

In the second part of his address, Dr. Burch turned to other of the end-results of Dr. Allibone's work on zirconium and its alloys. The Process and Insulation Department of Metropolitan-Vickers wanted to try the effect of a really good vacuum on the process of impregnating porous insulating materials with transformer oil, with the view of increasing the dielectric strength. One difficulty was that the impregnator had to work in a steam-jacket. The problem re-awoke in Dr. Burch an interest in distillation as a process worth experimenting with; in particular, vacuum distillation, if approached from the kinetic theory aspect, seemed promising, as a means of distilling substances which had not hitherto been distilled.

Accordingly, Burch, in association with Watts and Bancroft, constructed a vacuum still in which the condensing surface took the form of a cooled roof immediately above the evaporating pool of liquid, so that rate of distillation is limited only by rate of vapour creation. There was something of the 'heads-I-win, tails-you-lose' about the experiment, for either substances would distil in this still (and that would be useful in chemistry), or else they would not (and hence had very small vapour pressure and would be useful as sealing compounds for vacuum joints). After using the still for a week or so, the fascinating idea came to Dr. Burch that, since lubricating oil distilled in this still at temperatures 100° C. or so higher than that required for mercury, it might replace mercury in a condensation pump, and so dispense with 100° C. of artificial refrigeration in making high vacua. This made possible high-power demountable valves and X-ray tubes.

"So once more there were developments involving the co-operation of a great number of people. Dr. Allibone decided to develop demountable X-ray tubes, and eventually made the million-volt tube of the High-Voltage Department of St. Bartholomew's Hospital: Mr. Bancroft, Mr. Preece and Mr. Burrows made the pumps and the continuous vacuum still to make the oil for the pumps, and the vacuum stil with which Carr and Jewell of British Drug Houses first distilled vitamin A—for a wider group is involved than simply that of Metrovick. Further, we were not the only team to experiment with molecular distillation. While we were making our first still and quite independently, Dr. K. C. D. Hickman of the Eastman Kodak Co. in Rochester, N.Y., was tackling similar problems in very much the same way. Other teams from British Drug Houses, Imperial Chemica Industries, Shell-Mex and the Bataafsche Petroleum Mij. also co-operated in the development of application of molecular distillation.

"Returning to my own special interest—valves I made demountable 3-electrode valves, while my brother developed a 30 kW. demountable 4-electrode valve, which was so far as I know the first screen grid valve of that power made in Great Britain I should like to acknowledge our great debt to our colleagues in this work, Mr. Ludlow, Mr. Phillips Dr. Sykes, until his translation to the Nationa Physical Laboratory, and Dr. Dodds: if it was our privilege in the beginning to have given in some measure inspiration, it was their collaboration that made the development successful, and their inspiration that has carried it on. I should like also to express our gratitude to the radio staff of the Genera Post Office for their unfailing co-operation during the 'teething' troubles of demountable valves in the Rugby radio station.

"I have spoken of the co-operation of a team. But what of the man behind the team? Here should like to say specifically: All that my colleagues and I at Metropolitan-Vickers have achieved in this work, we owe ultimately to Dr. A. P. M. Fleming That raises the question: What of the future? How shall we choose men to do the kind of job that Dr Fleming is doing?

"I do not believe that a scientific man keenly interested in personal research is likely to be the bes man to choose for that kind of administrative work because his emotions will in general be too firmly linked with his personal research, and he will find it too difficult to dissociate these emotions in making judgments on points of policy. I think that a scientific man who has ceased to be interested in persona research may well develop the qualities needed for deciding questions of policy in long-term research especially if he retains or acquires an interest in the personalities of research workers, for I have the strong impression that the question of whether a particular line of work will or will not prove fruitful for a given organization may often be determinable less by logica than by psychological considerations. But, above all, avoid appointing a 'man of mature judgment'—and that phrase I take to imply a man whose judgments are determined entirely by his emotions whose emotions are keyed indissolubly to the events of his remote past, and who is totally unreceptive to new ideas except in so far as they may arouse fortuitously the emotions belonging to a bygone age

"I have touched on the psychology of the research worker, and that brings me to the question, What are the factors which determine whether a man shal be likely to have original ideas on a given subject and be keen to work on it? For a knowledge of these factors may well influence our policy in the education of research workers. I have just one suggestion to make : it is that at any rate for an appreciable percentage of researchers—I do not say for them all—we have to do with a factor which the psychologists ike to refer to in German (possibly because it is so marked a characteristic of the German nation) : a *Wiederholungsdrang* : a repetition urge : a tendency o repeat patterns in life. I would suggest, then, hat scientific or technological researches tend to be n some sense grown-up variants of some more youthful form of activity. If this is so, to find the ultimate foundations of success in research, we may well have to go back beyond the university—to the public school, or even to the preparatory school. Here I should like to acknowledge once more the very great debt that I owe to Oundle School, particularly in that they let me experiment with the small-scale semi-technical distillation of coal tar, because I wanted to. Coal tar at atmospheric pressure, 1918 : oil in a vacuum, 1928 !

"What of education in the future ? I look on it as an important indirect contribution to our long-term esearch policy to provide in our schools facilities for the keenest, at any rate, to follow up almost whatever kind of extra-curricular activity may strike their interest—and this without binding themselves in any way as to their future careers. This foretaste of achievement in following up individual interest provides, I believe, the strongest possible stimulus to education, and if the nature of the interest should change, the stimulus remains the same. The cultivaion of enthusiasm I take to form the first requisite in that far-sighted educational policy and that courageous long-term research policy to which I look forward in the future, after the War."

AGRICULTURAL DEVELOPMENTS IN THE U.S.S.R.*

By SIR JOHN RUSSELL, F.R.S.

PRIOR to the Revolution three systems of farming were practised in the U.S.S.R. : (1) large states ; (2) small peasant farms ; (3) peasant land armed by the peasants under the *Mir*, the village council or commune of very ancient origin.

Some of the large estates were run on good modern ines, some were put into the hands of managers whose business it was to extract all they could for the wner, others were moderately well managed. The easant farms were small holdings owned by the ndividual farmers, which had resulted from the arious agrarian reforms, the most important of the ater ones being those of Stolypin (1905), who had a Danish adviser and was aiming at the Danish model. The peasant land under the commune (*nadiel* land) belonged to the body of peasants but not to any individuals ; it was parcelled out into many strips which were periodically distributed by the *Mir* among the peasants in accordance with the size of family, etc. These strips were scattered over the whole area so that each man should have his share of good and of bad soil. In the time of the Revolution it was estimated that about 45 per cent of the cultivated land was in the hands of the peasants.

All three systems were disliked by the Bolsheviks, the first two because they involved private ownership f land, and the third because of its grave inefficiency and the utter impossibility of introducing modern improvements. The Bolsheviks also disliked the peasant mentality, so utterly different from that of the factory worker. The peasant wanted to sell his products at high prices while the factory worker wanted to buy them cheaply. The factory worker was accustomed to work in masses for an employer, and had before the Revolution no sense of proprietorship : the peasant was used to working alone or in small groups and always felt that he owned the land he tilled.

After some experiments, State farms were set up which accorded well with Bolshevik theory. The peasants were employees of the State receiving a weekly wage, living in great blocks of dwellings in a central area developed like a town. The whole organization resembled that of a factory, and it was expected that the peasants would develop the factory workers' outlook and become one with them. But the peasants did not like them and so they never developed : in 1938 only about 10 per cent of the cultivated land was worked as State farms, and they were used for special purposes. A completely different type of farm was set up, on the basis of the old *Mir*. The first were communes in which the whole body of workers was responsible for the full maintenance of each individual family ; but this did not answer. The *artel* organization was therefore adopted : another old Russian method which has no English equivalent. In this the workers feed and house themselves but the produce belongs to them, and after all outgoings have been met the balance is distributed according to the work done. The workers are paid in actual produce : mostly grain, potatoes, and vegetables, these being the main constituents of the peasants' dietary ; usually also there is hay for the workers' animals, and a small amount of cash. This method after suitable modification proved much more acceptable, and by 1939 a very large part of the cultivated land of the U.S.S.R. was farmed in this way.

The farms were called 'Collectives'. All the cultivated land in the village, whatever its previous ownership, was thrown into one big farm : it might be 1,000–4,000 acres or more, but was not usually unmanageable in size. All the peasants of the village could come into the group, but preference was given to the so-called 'poor peasants'. The plan of production was until just before the War sent from headquarters : it had been discussed during its development, but once settled, it could not be further discussed. The workers elected a committee to carry it out and to allocate the tasks to the different people ; the chairman, however, was not freely elected as he had to be accepted by the Party and the Government ; he often came from outside and did not usually stay long. The Party always insisted on keeping its hold on the farms, and it had its representative, who was quite independent of the committee.

Payment was always by the piece ; a certain job of work was called a "labour day", and when a man had done this he was credited with one day's work. Not infrequently about two hundred would be done during the year, but specially good workers would put in many more. The worker could eat his share of the produce or sell it to the farm, the Co-operative or in the peasant market.

The workers' share of the produce varied with the yields and the outgoings. The Government's share has varied. For some time prior to 1939 it was a fixed amount per acre of winter grain sown, and of spring grain ordered to be sown, also a fixed quantity of milk and meat per animal kept. A small price was paid, much below the market price. In 1939 more latitude in planning was allowed so long as the stipulated Government share was duly delivered. As this was fixed while yields were variable it is impossible to state any definite percentage; but an average of a number would lie between 15 to 20 per cent. Then the machine tractor station, the Government organization that hired out the tractors, combines and other big tackle and supplied the drivers had to be paid: this might take another 15 per cent. Seed for next season and fodder for winter had to be set aside: this also might amount to about 15 per cent. Insurance, administration, sick and needy people, maintenance, capital developments, and other farm overheads had also to be provided for. One way and another, more than half the produce would go, and the workers' share might be 40 per cent or less.

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* Substance of a lecture at the Central Council for Health Education Summer School held in London during August.

A great change in the system, and in the peasants' attitude to it, came when the Constitution of 1936 gave the collective farms the use of their land for ever, and also gave each member the use of his cottage and its garden and a holding varying from ½ acre to 2½ acres on which he could keep such animals as he and his family could look after. So popular were these holdings that by 1939 much of the peasants' time was spent on them and a large proportion of the livestock of the U.S.S.R. was their private property. So decrees went forth that they must put in a minimum of a hundred days per annum on the farm; this number has since been raised.

There is little doubt that when peace returns this modified system will be able to provide the U.S.S.R. with the food needed for a rising standard of life. The theoretical objection still remains: the peasants are not employees and do not come under the labour code: they have, for example, no trade union and are ineligible for old-age pensions. 'Peasant-mindedness' still continues and they are not one class with the factory workers. But so many theoretical difficulties have been brushed aside in the U.S.S.R. for a realistic solution that we may expect this also will disappear and the system will become wholly acceptable.

PREPARATION OF A GIANT STRAIN OF *Torulopsis utilis*

By DR. A. C. THAYSEN and MURIEL MORRIS
Chemical Research Laboratory, Teddington

IN the microbiological synthesis of protein it has been observed that the complete separation of the yeast produced from the fermented wort offers certain difficulties when *Torulopsis utilis* is used as the active organism. These difficulties are due primarily to the considerable variation in cell-size of the organism, some cells being as small as 3 μ × 5 μ, or less than half the size of the average cell of this organism. Moreover, these smaller cells appear to be particularly numerous towards the end of the fermentation period, when they represent quite an appreciable percentage of the total. Since they remain more tenaciously suspended in the fermented wort than the larger cells, they easily cause a drop in yield when the yeast is separated in the centrifuge or the filter press, through the filter cloth of which they pass more readily than the larger cells. It was felt that if a method could be devised by which the size of the cells of *Torulopsis utilis* could be permanently increased, the manufacturing difficulties referred to might be largely overcome.

It might be anticipated that the most likely way of producing a strain of *Torulopsis utilis* with cells larger than the standard would be by treating the original strain with colchicine, but Blackslee's[1] and Richards'[2] attempts at influencing the nuclear divisions of various mycelium-producing fungi, bacteria and strains of *Saccharomyces cerevisiœ* in this way were unfortunately not encouraging, as they gave entirely negative results. There seemed little hope for expecting, therefore, that success might be achieved with *Torulopsis utilis*. However, it was felt that an attempt should be made to determine the effect of colchicine on *Torulopsis utilis*, if for no other purpose than to confirm that Richards' observations on strains of Saccharomyces apply equally to the non-spore-forming *Torulopsis utilis* type of 'yeast'.

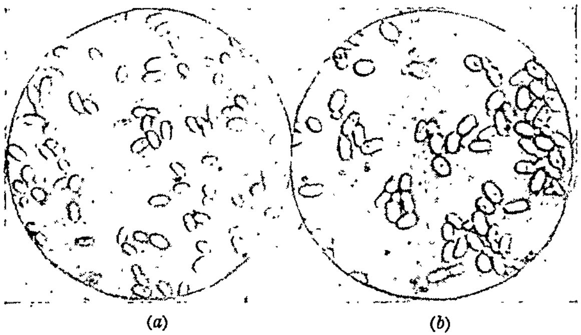
To do so a set of experiments was carried out in which increasing quantities of colchicine, from 1 mgm. to 100 mgm., were added to ordinary wort agar which was poured into Petri dishes, each seeded with about a hundred cells of a fresh culture of *Torulopsis utilis*. The various plates, as well as one or two control plates of ordinary wort agar without colchicine addition, were incubated at 30° C. and the time noted for colonies to appear. In addition, the number of colonies on the plates were counted and the rate at which growth progressed noted.

Even at colchicine concentrations of 100 mgm per 10 ml. wort agar, no influence could be detected of an action of the alkaloid on the growth of *Torulopsis utilis*, and measurements taken of the size of the cells differed in no way from those of cells of the control strain grown on ordinary wort agar. The observations of Blackslee and Richards therefore apply also to *Torulopsis utilis*, the nuclear functions of which whatever they may be, remain unaffected by colchicine.

Recently attention has been directed by Bauch to substances other than colchicine which influence mitosis and may give rise to the production of giant cells. Among these substances is α-naphthylamine

The effect of this substance on the cells of *Torulopsis utilis* was studied by us in a series of experiments in which increasing amounts of this chemical were added to wort agar, afterwards seeded with *Torulopsis utilis* cells in numbers to yield approximately a hundred colonies per test culture. Starting with 1 mgm., the concentration of α-naphthylamine was gradually increased to 60 mgm. per 10 ml. of wort agar. It was observed that quantities up to 20 mgm of α-naphthylamine had no influence on the numbers of colonies appearing on the test plates after incubation at 30° C., nor could any change be seen in the size of the cells produced. On the plates containing 25 mgm. and 30 mgm. of the chemical, only 30 per cent of the seeded cells gave rise to colonies, while the plate containing 40 mgm. of α-naphthylamine allowed only 1 per cent of the inoculated cells to grow. The plate with 50 mgm. of α-naphthylamine remained sterile. It was noticeable that the shape of the cells on the plates with high concentrations of α-naphthylamine had changed from the normal egg-shape to spherical. The volume, however, had not been increased.

A single cell of the spherical type was removed by the micromanipulator and grown in liquid wort at 30° C. The ensuing culture was found to be



(a) CELL OF STANDARD STRAIN OF *Torulopsis utilis*. × 440.
(b) CELL OF CAMPHOR-GROWN STRAIN OF *Torulopsis utilis*. × 440.

composed of normally-shaped cells. The effect of α-naphthylamine, therefore, had been transient and unable to affect the nuclear functions of the organism exposed to it.

Prior to his reference to α-naphthylamine as a mitosis-toxin, Bauch[4] had mentioned, in passing, that camphor affected mitotic changes in brewer's yeast and other fungi, resulting in the production of giant cells. Without giving details of his procedure, Bauch reported that the action of camphor resulted in the doubling of the chromosome number of the cells affected.

It was decided to study the effect of camphor on *Torulopsis utilis* on the lines previously used for colchicine and α-naphthylamine. The amount of camphor added to plates each containing 10 ml. of wort agar ranged from 5 mgm. to 50 mgm. Each of the plates was seeded with about a hundred cells of a fresh culture of *Torulopsis utilis* grown on wort agar, and incubated at 30° C.

It was found that with camphor additions of 20 mgm. or less, growth of *Torulopsis utilis* proceeded undisturbed at the temperature chosen, and there was nothing to indicate that the size of the cells had been affected. At camphor concentrations of between 25 mgm. and 30 mgm., the growth of the inoculated cells into colonies was impeded at first and could not be detected macroscopically until two days after the formation of visible colonies on the control plates. The number of colonies eventually appearing on the plates containing 25 mgm. of camphor was not noticeably smaller than that on the controls, but on the plates containing 30 mgm. of camphor only a few of the seeded cells gave rise to macroscopically visible colonies. In these colonies marked changes had taken place in the size of the individual cells, and measurements revealed that the average size (from twenty separate determinations) had increased from $3 \cdot 8\ \mu \times 7\ \mu$ for the standard strain of *Torulopsis utilis* to $4 \cdot 8\ \mu \times 8 \cdot 9\ \mu$ for the cells of the strain grown on camphor. These dimensions would correspond with a difference in volume of $326\ \mu^3$; $318\ \mu^3$ being the volume of the cell of the standard strain and $644\ \mu^3$ that of the cells of the camphor-grown strain. The accompanying photographs illustrate the difference between the size of the cells of the two strains.

By means of a micromanipulator a single cell was isolated from a colony on the plate containing 30 mgm. of camphor and subcultured in ordinary wort agar. The resulting culture was catalogued as *Torulopsis utilis* var. *major*.

Torulopsis utilis var. *major* has been subcultured over a period exceeding one year and has retained unimpaired its most significant characteristic, the increased cell volume.

Attempts have been made to increase still further the volume of the cells of the new strain by growing it on wort agar containing camphor, but without success. It was noticed in these experiments that growth of the inoculated cells on the camphor medium was temporarily impeded when the camphor concentration reached 30 mgm. per 10 ml. wort agar, and that only a few of the seeded cells eventually grew into colonies. Beyond a concentration of 30 mgm. of camphor in 10 ml. of wort agar, no growth at all took place.

The size of the cells of the developing colonies did not differ from that of *Torulopsis utilis* var. *major* cells. It was concluded, therefore, that an increase in size beyond that already achieved was impossible and that in this respect *Torulopsis utilis* differed from that of the Saccharomyces strains studied by Bauch.

Having obtained a strain with cells considerably larger than those of the original *Torulopsis utilis*, the new type was submitted to various tests in order to determine its suitability for food yeast production.

In the first place the strain was compared with the standard culture of *Torulopsis utilis* in its ability to separate from the spent wort of a fermented molasses wort. It was found that both in the centrifuge and in the filter press the cells of *Torulopsis utilis* var. *major* could be more readily separated than the cells of the standard strain. It remained to be ascertained whether the new strain possessed the valuable properties, as regards protein and vitamin content, of the mother strain and would give as large yields of yeast per unit of carbohydrate consumed as the latter.

The results of a comparative examination of the two strains are given in the accompanying table.

	Torulopsis utilis	*Torulopsis utilis* var. *major*
Size of cell	$3 \cdot 8\ \mu \times 7\ \mu$	$4 \cdot 8\ \mu \times 8 \cdot 9\ \mu$
Volume of cell	$318\ \mu^3$	$644\ \mu^3$
Yield of dry yeast on sugar fermented	59–60 per cent	59–62 per cent
Protein content of dry yeast	55·3 per cent	56·0 per cent
Phosphorus content of dry yeast	1·8 per cent	2·8 per cent
Aneurin content of dry yeast	20 μ gm. per gm.	20 μ gm. per gm.
Riboflavin content of dry yeast	60 μ gm. per gm.	60 μ gm. per gm.
Taste of dried yeast	Slightly meaty	Slightly meaty
Colour of dried yeast	Light buff	Light buff
Generation time under standard conditions of fermentation	100–110 min.	58–90 min.
Optimum temperature	30° C.	30° C.

Thus in every one of the above-mentioned characters, except those of size and generation time and possibly in phosphorus content, the two strains were identical.

The significance of the shorter generation time will be referred to in greater detail in a subsequent report, and it may therefore suffice to state here that the shorter generation time should offer advantages in speeding up the output of yeast from any given capacity of fermentation plant.

Discussion

The experiments reported above have shown that Bauch's claims to have produced giant cells from various Saccharomyces species by exposure to camphor vapours applies equally—though to a limited extent—to at least one Torulopsis species.

The increase in size of cells of *Torulopsis utilis* is limited to a doubling of their volume. Repeated application of the camphor technique leads to no further change.

The doubling of the cell volume has been found to be permanent, even in cultures of the new strain which have not had contact with camphor for hundreds of generations, an observation which proves that very deep-seated changes have resulted from the original exposure.

It has not been possible, so far, to determine whether the increase in cell volume can be correlated with an increase in nuclear substance. Further work in this direction is contemplated. In this connexion it may be significant that in one experiment it was observed that the percentage of nucleic acid extractable from a given weight of cells of the new strain was considerably greater than that obtained from the same weight of cells of the standard *Torulopsis utilis* strain.

It is of interest also to record that the cells of *Torulopsis utilis* var. *major* show a greater tendency to autolyse than the cells of the standard strain. In this connexion, therefore, the new variety behaves like the thymus cells studied by Dustin and his collaborators under the influence of karyoklastic toxins, that is, toxins which among their numbers include colchicine but not camphor. Chodkowski[5] has given an interesting account of Dustin's theory of the functioning of karyoklastic toxins.

With the knowledge that camphor in certain concentrations is capable of producing deep-seated changes in the cell-volume of *Torulopsis utilis*, it was thought of interest to find out whether other bicyclic terpenes would have a similar effect. So far, it has been possible to show that two further members of the camphor system, borneol and bornyl acetate, and one of a different terpene grouping, camphene, are capable of inducing what appears to be the same changes in cell volume as camphor itself. The significance of this observation is being followed up.

Summary

Under the influence of camphor, the cells of *Torulopsis utilis* undergo deep-seated changes which result in the permanent increase in their volume. By such influence a new strain of *Torulopsis utilis* has been produced, and designated *Torulopsis utilis* var. *major*, which in its biochemical properties is identical with that of the mother strain, though it differs from it in certain mechanical characteristics and physiological behaviour. Further, it has been found that other bicyclic terpenes than camphor may react on *Torulopsis utilis* in the same manner as camphor itself. Colchicine and α-naphthylamine were found to be incapable of increasing the cell volume of *Torulopsis utilis*.

We are grateful to Dr. Harriet Chick of the Lister Institute of Preventive Medicine for the assay of the aneurin and riboflavin content of the two strains of *Torulopsis utilis*.

The work described above was carried out as part of the programme of the Chemistry Research Board, and is published by permission of the Department of Scientific and Industrial Research.

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[1] Blackslee, A. F., *Science*, 89, suppl. 28.4, p. 10 (1937).

[2] Richards, O. W., *J. Bact.*, 36, 187 (1938).

[3] Bauch, R., *Naturwiss.*, 29, 503 (1941).

[4] Bauch, R., *Naturwiss.*, 29, 673 (1941).

[5] Chodkowski, K., *Protoplasma*, 28, 597 (1937).

OBITUARIES

Dr. G. E. Pilgrim, F.R.S.

WITH the death on September 15, at Upton near Didcot, Berkshire, of Dr. Henry Guy Ellcock Pilgrim, vertebrate palæontology has lost one of its most distinguished exponents, and the world's greatest authority on the rich Siwalik fauna of India. Pilgrim, who came of an old Barbadian family, was born at Stepney, Barbados, on December 24, 1874. He was educated at Harrison College, Barbados, and University College, London (D.Sc., 1908); he was appointed to the Geological Survey of India in 1902, from which he retired in 1930, having been a superintendent since 1920. He then became a member of the supernumerary staff of the Department of Geology, British Museum (Natural History). He was elected a corresponding member of the Palæontological Society of America (1925), a fellow of the Asiatic Society of Bengal (1925), and, very belatedly, a fellow of the Royal Society (1943). He was president of the Geological Section of the Indian Science Congress in 1925. During the War of 1914–18 he was attached as 2nd lieutenant to the 125th Napier's Rifles, and received war medals for service in Mesopotamia and Persia, 1916–19.

Pilgrim's work with the Geological Survey of India can be divided into two main sections: as a geologist, and as a palæontologist. His most important stratigraphical work was divided between two problems, namely, (1) the survey of portions of Persia and Arabia; and (2) the Siwaliks and other Tertiary freshwater deposits of North-Western India, including Baluchistan.

The Persian Gulf work was done in two visits, and has been described in two *Memoirs of the Geological Survey of India* (34, Pt. 4; 1908: and 48, Pt. 2; 1924). In these two memoirs he described the geology of much country that had not previously been visited by a geologist, incorporated the work of earlier workers where this was of value, and laid down the succession of formations in Persia from Pre-Cambrian to Recent, introducing a nomenclature that has in the main been adopted by later workers.

Pilgrim was not only the first geologist but also the first European to visit parts of Trucial Oman in Arabia. He was also the first geologist to visit Bahrein Island in the Persian Gulf, which he mapped. He showed that the structure was that of a dome, and this led later to boring for oil, and a flourishing industry is now established in Bahrein.

Still more important scientifically is Pilgrim's geological work in India. The Siwalik formation, so famous for its fossil vertebrates, had not been previously subdivided, except into a lower apparently unfossiliferous section and an upper fossiliferous section. Strata 15,000–20,000 ft. thick had all been lumped together, and the fossils derived from several stages all mixed together; these fossils had been described merely as zoological specimens without any knowledge of their relative ages, except such as could be surmised by comparison with fossils elsewhere. To Pilgrim belongs the distinction that he reduced this muddle to order. He showed that there are three separate fossiliferous divisions to the Siwaliks, each with its characteristic vertebrate fossils, and in his "Preliminary Note on a Revised Classification of the Tertiary Freshwater Deposits of India" (*Rec. Geol. Surv. India*, 40; 1910), he sorts out two hundred species of Indian vertebrates among his three divisions of the Siwaliks and the underlying Nari beds, and assigns ages in terms of European nomenclature ranging from Aquitanian to Pliocene. Fifty of these species are of his own discovery. In a later paper, "Correlation of the Siwaliks with Mammal Horizons of Europe" (*Rec. Geol. Surv. India*, 43; 1913), he succeeds in splitting up the Tertiary freshwater strata of India and Burma into no less than thirteen horizons with their characteristic fossils, ranging from the Gaj below to the Boulder Conglomerate at the top of the Siwaliks. He shows the European equivalent of each horizon, and also the equivalence of the freshwater strata with the marine Tertiary beds of India. His correlation has been of immense use to all later workers on the Tertiaries of India.

Pilgrim also made an expedition to Bhutan, and wrote a joint memoir, with Mr. W. D. West, on the geology of a portion of the Simla Hills.

With the help of the late Mr. Vinayak Rao, Pilgrim added largely to the already large collections of Siwalik vertebrate fossils in the Geological Museum in Calcutta, and he thus had at his disposal an immense mass of material, partly already described in the past by Lydekker and partly new. To this material Pilgrim devoted all available time while in the Indian service, work that he continued in London at the Natural History Museum after his retirement. The total result is an impressive mass of fine memoirs in the *Palaeontologica Indica* descriptive of various groups of Indian vertebrates, of which one may list in chronological order the Giraffidæ of India (1911), the Vertebrata of the Gaj of the Bugti Hills and the Punjab (1912), the Perissodactyla of the Burma Eocene (1925), the Suidæ of India (1926), the Artiodactyla of Burma (1928), the Carnivora of India (1932), and finally the Bovidæ of India (1939). Separate mention may be made of Pilgrim's discoveries of fossil primates in the Siwaliks, comprising no less than five new species and two new genera. In his view Sivapithecus, one of these latter, was, when he wrote (1915), the closest anthropoid phylogenetically to man, with the possible exception of Pithecanthropus and Eoanthropus.

The preparation of this note has been a sad task for me, for Pilgrim, the late James Malcolm Maclaren and I travelled out to Calcutta together in 1902, on the P. and O. *Coromandel*, to join the Geological Survey of India. L. L. FERMOR.

Prof. H. G. Denham

THE death, which occurred on February 15, 1943, of Prof. Henry George Denham, professor of chemistry in, and rector of, Canterbury University College, Christchurch, New Zealand, and chairman of the New Zealand Council of Scientific and Industrial Research, has deprived the University of New Zealand of a distinguished teacher, administrator and investigator, and both the Dominion and the British Empire of a man who had done eminent public service in vigorously fostering the advancement of pure and applied science in his native country.

He was born in Christchurch on July 14, 1880, and received his early education at Sydenham School, whence he proceeded with a scholarship to the Boys' High School. Having completed his school education, he adopted school teaching as a profession, but while still engaged on this work entered Canterbury College as a student in 1901. Here he decided to study chemistry as his main subject when Dr. W. P. Evans was appointed to the chair of chemistry in 1903. He won the Chemistry Exhibition and graduated B.A. in 1904 and M.A. with first-class honours in chemistry in 1905. Having carried out an investigation on the temperature of combustion of methane in the presence of palladiumized asbestos, he obtained the M.Sc. degree and won the 1851 Exhibition Science Research Scholarship in 1906. In the same year I had the good fortune to welcome him as a research student in the Muspratt Laboratory of Physical and Electro-Chemistry, University of Liverpool. Denham's cheery and good-natured personality and his keenness and enthusiasm for research in physical chemistry were a great source of strength to the newly opened laboratory, whither a few years later were to come three other very able young New Zealand investigators—Prideaux, Farrow and Stubbs.

Denham proved to be an exceptionally gifted research student. His first work was the determination of the degrees of hydrolysis of salts in aqueous solution by means of the hydrogen electrode. This novel and pioneering piece of electrometric research led Denham on to two other very interesting lines of investigation. Having found that in the presence of the hydrogen electrode anomalous values for the hydrogen ion concentration in solutions of lead salts were obtained—results which could be explained only by the assumption of a partial reduction of bivalent to *univalent* lead ions at the surface of the platinum-hydrogen electrode—he joined forces with A. J. Allmand, then a research student in my laboratory. By means of an automatic thermo-circulation apparatus they caused a solution, say, of lead acetate, to pass constantly upwards through a hot steam-jacketed column containing metallic lead and then downwards through a cooled column (of the same solution). In this way they found that metallic lead crystallized out from the solution in the cooler part, a result which could be best explained by the reversible equilibrium

$$\mathrm{Pb}^{++} + \mathrm{Pb} \underset{\text{cooling}}{\overset{\text{heating}}{\rightleftarrows}} 2\mathrm{Pb}^{+},$$

similar to that which occurs in the case of copper and gold salts. Encouraged by this remarkable result, Denham then went on alone to apply the same method to other salts and demonstrated the existence in aqueous solution of a univalent cadmium ion, a 'subvalent' thallium ion (Tl_2^+) and a bivalent bismuth ion. In the electrometric investigation of the hydrolysis of salts of zinc, magnesium, thorium, cerium, nickel and cobalt, Denham found that very irregular and fluctuating results were obtained. These he explained by the assumption of the existence of a microheterogeneous system, that is, the presence of colloidally dispersed hydroxides or basic salts in the solution. A closer examination of these 'anomalies' led to the publication of an interesting paper. In connexion with this work it may be mentioned that Kolthoff and Kameda in 1928 explained the anomalous results as due to the adsorption of metal cations on the platinum black. The equivalent amount of hydrogen ions liberated in the solution upsets the hydrolysis measurement. The work on the hydrolysis of salts was completed by an electrometric determination (with the hydrogen electrode) of the degrees of hydrolysis in aqueous solution of the blue and green chromic sulphates.

Denham's last piece of work in my laboratory dealt with the formation of 'autocomplexes' (anionic complexes) in solutions of cupric chloride, cupric bromide and cobalt bromide, in which an ionic transport method was employed. For his excellent research work he was awarded the D.Sc. degree by the University of Liverpool. Denham then went to continue his researches in Germany, and having arrived in the laboratory of Prof. Bredig at the University of Heidelberg he informed Bredig that he wished to work for the Ph.D. degree of that University but could only spend about a year on the job. Prof. Bredig was astonished, said that such a thing was very difficult if not impossible—but he could have a shot at it if he wished! Little did he realize Denham's tremendous powers of concentration and hard work, not to mention his great insight and skill as an investigator. The result was Denham did so well that he got his Heidelberg Ph.D. in the year. His subject of investigation was a quantitative study of the reversible catalytic reduction of titanic salts by hydrogen gas (in presence of platinum black). It formed one of Bredig's great series of studies in heterogeneous catalysis.

With a record of six published papers and the research degrees of two European universities (a pretty good record for 3½ years work), Denham returned to New Zealand in 1910 and acted for a time as research student and honorary lecturer at Canterbury College. Then in 1912 he obtained a post as lecturer in chemistry under Prof. B. D. Steele at Brisbane (University of Queensland), where he was appointed head of the Chemistry Department and acting-professor during the absence of Prof. Steele on war-work in England, obtaining the title of assistant-professor at the end of the War.

In 1921 Denham published his useful text-book of inorganic chemistry, and in the same year was appointed professor of inorganic chemistry at the University of Cape Town, remaining there only two years, for in 1923 he was offered and accepted the succession to the chair of chemistry at Canterbury College, Christchurch—a post which he still occupied at the time of his death. From 1941 he held also the high office of rector of the College. During his twenty years as professor, Denham proved himself to be a very active and excellent university teacher and administrator, the much-loved father of his students, and a wise, energetic and forward-looking member of the academic body. He was a member of the Academic Board of the University from its inception in 1927, and a representative of that Board on the University Senate from 1935. Apart from his great work in University and College affairs, Denham was very active in fostering and promoting the advancement and application of science in New Zealand. He was a fellow of the Royal Institute of Chemistry of Great Britain and Ireland, an original fellow of both the Australian Chemical Institute and the New Zealand Institute of Chemistry, and a fellow of the Royal Society of New Zealand and of the New Zealand and Australian Association for the Advancement of Science. Of the latter body he was president of Section B (Chemistry) for the Hobart meeting in 1928, and Liversidge Lecturer for the Canberra meeting in 1939.

Denham took a very active and important part in the promotion and development of scientific control and research in connexion with both primary and secondary industries in New Zealand. Thus he was a member of the New Zealand Council of Scientific and Industrial Research from its establishment in 1926, becoming chairman in 1934. He was active in the foundation of the Wheat Research Institute in 1927 and chairman of its committee from the start. Denham's interest in the successful promotion of agricultural science and practice can be realized when it is stated that he was a member of the Board of Governors of Canterbury Agricultural College during 1928–41 and its chairman during 1932–38; a member of Council of the New Zealand School of Agriculture from its foundation in 1937 until 1941, and a member of the committees of the Dairy Research Institute and the Wool Manufacturers' Association.

During his stay in Brisbane and Cape Town, Denham published a number of papers on complexes in solutions of copper and cobalt salts and on the existence and preparation of the suboxides and subsalts of lead, cadmium and bismuth. Some doubt has been cast on the existence of certain of these suboxides and subhalides by the later work of Hollens and Spencer (1934), using magnetic susceptibility measurements, and by that of Hedger and Terrey (1936) using X-ray methods. Some of the substances in question were prepared by methods which Denham's work had also shown to be doubtful.

During his busy years as professor at Christchurch, Denham never lost his interest in research, and in collaboration with senior students published a number of papers on salt hydrolysis and on the ternary systems zinc oxide – nitric acid – water and lead oxide – nitrogen pentoxide – water.

The coming of the War brought new and heavy burdens. He threw himself fully into the great war effort of New Zealand, but there seems little doubt that this extra strain was too much for a man who had never spared himself in his devoted services to his students, the University, the community and science. Fortunately, he lived long enough to know of the great honour that was coming to him, namely, honorary membership of the Society of Chemical Industry.

As one of his old teachers, I have always had the highest regard and affection for him, and count it a special piece of good fortune for myself that I was able to help him at an early stage in his career. He was a great son of his native land, and a very fine example of a man who devoted himself wholeheartedly not only to the advancement of science and sound learning but also to the promotion of the health, happiness and prosperity of his fellow countrymen by the means which science can provide.

F. G. DONNAN.

Sir Michael Sadler, K.C.S.I., C.B.

THE death of Sir Michael Sadler removes from the world of education an elder statesman universally honoured for his achievement and almost as widely trusted for his wisdom. He was never, as too many of our educationists are apt to be, merely the brilliant amateur in the field, or the politician in disguise. Both these parts he could have played to perfection, if he had so chosen, for he had the gift of persuasive eloquence and great personal charm. At Oxford he became president of the Union in his second year, but made no mistake about his first classes in the Schools. Then in 1895 he settled down to the Oxford University Extension work, shaping in a very short time the main lines which it has since followed. He passed on almost at once to spend eight years as director of special inquiries and reports at the Board of Education, and used the opportunity to conduct a thorough study of what was being done outside Great Britain, particularly in Prussia and generally

Germany. It was a period in which he not only tended his own knowledge far and deep, but also oduced a series of vitalizing documents which gave nfidence and purpose to the educational movement ich began in 1902. In that year it can be safely serted that no Englishman knew more about educa- on at all its stages in all the countries that mattered an Sadler, and certainly there was no one more pable of expressing what he knew. It was natural at his knowledge and powers should be freely used. one hand he became for a brief period professor the history and administration of education at anchester, and then vice-chancellor of Leeds; on e other, he found time to plan the secondary and gher education of Sheffield, Liverpool, Birkenhead, uddersfield, Exeter, Newcastle-upon-Tyne, Derby- ire and Hampshire. This series of signal public rvices culminated in his presidency of the Calcutta iversity Commission and his monumental report Indian education. His long apprenticeship had rne abundant fruit, and all of it came to maturity. ter, he returned to his old University as master University College, continuing to be until his retire- nt and after it a source of inspiration and life in e many causes to which he laid his hand: in the niversity and in the City, of which he became a eeman; in the Oxford Preservation Society; and in movements for the encouragement and better derstanding of modern art and promising artists.

He could deliver a formal oration of perfect classical m, and equally could speak with eloquence and e on the spur of the moment in a company large or all. He had the gift of throwing his entire self into atever engaged his interest, and partly because this he won the devotion and admiration of many ung people. He radiated friendliness, and it was t for nothing that Leeds during his vice-chancellor- ip was spoken of as "the friendliest in the country". attracted youth also because he was little in- ested in what was already established and con- ntional, but was ever looking for promise and the ovement of the future. It is significant of this ality in him that at Headington his fine Gainsboroughs were not given pride of place, but were kept in the shade by his remarkable collection of modern examples, which much resembled the wheat and the tares alike growing together for the harvest; and it must be confessed that he liked to shock convention to the extent of advancing paradoxes in which he did not entirely believe himself. It has been said that the Greeks were always children, and Sadler in the same way kept something of the eternal boy. He told a select gathering of heads of houses at Oxford that in a generation Oxford and Cambridge would be moss-grown relics of the past, and the intellectual life of the country would have passed to Leeds, Manchester and Birmingham. He blandly advocated a by-pass to bisect Christ Church meadows, partly because he liked by-passes as being strong, broad and direct, like himself, and partly he wanted to observe the shock with which Oxford would react to this assault on one of its most treasured beauties.

He had a happier life than is given to most: he has left us the record of a great and lovable man.

CYRIL NORWOOD.

WE regret to announce the following deaths:

Prof. Leon Asher, emeritus professor of physiology in the University of Berne, on August 8, aged seventy-eight years.

Prof. H. L. Lebesque, For.Mem.R.S., professor of mathematics in the Collège de France, during 1941, aged sixty-eight.

Prof. Einar Lönnberg, the well-known Swedish zoologist, on October 21.

Mr. Cecil Rowntree, the distinguished surgeon and authority on cancer treatment, on October 14, aged sixty-three.

Sir Aurel Stein, K.C.I.E., F.B.A., the authority on Central Asian antiquities, on October 26, aged eighty.

Mr. W. P. Westell, formerly curator of the Letchworth Museum and well-known lecturer and writer on natural history, on November 1, aged sixty-eight.

NEWS and VIEWS

oodwardian Chair at Cambridge: Lieut.-Colonel W. B. R. King, O.B.E., M.C.

LIEUT.-COLONEL W. B. R. KING has been appointed oodwardian professor of geology in the University of mbridge. He has the unique distinction of having en the chief representative of British geology ectly employed as a geologist in both world wars. won two awards on the Western Front: an B.E. for geological services in the War of 1914–18, d an M.C. for non-geological actions connected with e evacuation of the British Army from France in 40. In peace, Colonel King was a member of the ological Survey of Great Britain from 1912 until his pointment as Prof. Marr's assistant at Cambridge in 20. Eleven years later he was elected to the Yates- ldsmid chair of geology at University College, ndon.

Colonel King's publications are an index to his wide erests. Among them we find contributions to læozoic palæontology and stratigraphy, largely awn from the north of England and Wales, but in- ding also descriptions of fossils from the Middle East and India; gleanings from his war experience of the Mesozoic and Tertiary formations of the Continent; interpretations of North of England scenery; and a co-operative excursion into the marches of geology and archæology, so well represented in the Pleistocene of the Thames Valley. Colonel King's past experience on the Geological Survey has given a special character to his open-air teaching of his subject. In another direction, he will be remembered as a popular secretary of the Geological Society.

New Master of Birkbeck College: Prof. H. Gordon Jackson

WITH the appointment to the mastership of Birkbeck College, London, of Prof. H. Gordon Jackson, who has been head of the Zoology Department there since 1921 and professor since 1928, the Governors seem to have followed a similar course as towards the end of the War of 1914–18, when the late Dr. Senter was appointed to that position. Thus during the important period of reconstruction which the College looks forward to after the War, there will be in charge one who is familiar with the rather special conditions which obtain there. To zoologists Prof. Jackson is best known for his numerous papers on the systematics of the terrestrial Isopod Crustacea and on the comparative anatomy of the Isopod head; but his colleagues are familiar, too, with the imperturbable good humour, the careful planning and the absolute fairness with which he has presided over numerous bodies in his College and University, while large numbers of former students recall with great enjoyment the lucidity and wit of his lectures, and his uncanny knack of selecting precisely the most apt metaphor or simile for driving home a point of difficulty. In view of the damage sustained by the College during the raids of 1940–41 and the part which Birkbeck College is bound to play in University education after the War, the transfer of the College to the Bloomsbury site is one of its most urgent problems. Prof. Jackson's many high qualities will, we feel, ensure an early solution.

Tercentenary of John Bainbridge

When Sir Henry Savile (1549–1622), while holding the post of warden of Merton College, Oxford, founded the Savilian professorships of geometry and astronomy at Oxford in 1619, the first of these was given to Henry Briggs (1561–1630), who had held the chair of geometry at Gresham College, London, while to the second was appointed John Bainbridge, a London physician who had just published a description of a comet observed in November 1618. Bainbridge on his appointment was thirty-seven, and he continued to hold his chair until his death on November 3, 1643. Born at Ashby-de-la-Zouche, he had studied at Emmanuel College, Cambridge, and had qualified in medicine. While teaching and practising he devoted his leisure to mathematics and astronomy. Removing to Oxford in 1620, he continued his study of the writings of the Greeks and Arabs, and though he published but little, he left a considerable number of manuscripts. These he bequeathed to his friend, the learned but unfortunate Archbishop James Ussher (1581–1656), whose library, after various vicissitudes, passed to Trinity College, Dublin. Bainbridge died at his house opposite Merton College, and after an oration by William Strode, his body was laid beside that of Briggs in Merton College Chapel.

Aeronautical Medals

The Royal Aeronautical Society has recently acquired, through the generosity of an anonymous donor, a remarkable collection of more than three hundred aeronautical medals, dating from 1714 to 1941. The medals are a veritable history of aeronautics, struck on the occasion of some aeronautical event. Three of the early medals were struck in 1783 to commemorate the first ascent of the Montgolfier Brothers in a hot-air balloon; two others show the first ascent of Lunardi from London in 1784; another the first Dutch aeronaut to ascend, from Amsterdam, in 1806. James Sadler, the first Englishman to make an ascent, is commemorated in a medal dated 1811. A silver medal of 1851 shows the ascent of three balloonists each on a horse! There are many examples of the Siege of Paris medals of 1870, Giffard's ascents and others. A bronze medal of 1896 shows the Andrée polar balloon, and several silver ones of 1901 Santos Dumont's dirigible. Coming to later days, there is a medal of 1909 commemorating the award of the Congress Medal to the brothe Wright; medals of various Zeppelins, Parseval, t *R*.101 and other dirigibles; medals commemorati Bleriot's cross-Channel flights, 1909; the flights Paulhan (London–Manchester, 1910); Chavez (cros ing the Alps, 1910); Lindbergh (trans-Atlant flight, 1927); Hinkler (London to Australia, days, 1928); Kohl, Hunefeld and Fitzmauri (Ireland to America, first east–west flight, 1928); a Prof. Picard and Dr. Kipfer (first stratosphere asce 1931).

Collaboration in Fuel Research

The Standing Consultative Conference on F Research, which has been constituted by the Depa ment of Scientific and Industrial Research to p mote collaboration among the various resea associations or equivalent organizations engaged fuel research, and between them and the Departmen Fuel Research Organisation, had a preliminary me ing on October 21 at which representatives of Ministry of Fuel and Power, the British Coal Utili tion Research Association, the British Electrical a Allied Industries Research Association, the Brit Refractories Research Association, the Gas Resea Board, British Iron and Steel Federation (Indust Research Council), and British Hard Coke Resea Association were present. In his opening rema Sir Edward Appleton, who presided, briefly descri the objects which the Department had in view setting up the Conference, and emphasized t membership is voluntary and at the invitation the Department. The Conference is intended provide a convenient means whereby the resea organizations may keep in close touch with e other, and assist each other by interchange of formation and by friendly discussion. Members the Conference described briefly the aims and sc of their organizations and then discussed arran ments for the setting up of a central body to und take the preparation and publication of abstracts current literature relating to fuel and the maint ance of a register of translations. It was deci that the next meeting should be held early in Janu 1944, when the fuel research programmes of the m ber organizations would be considered by Conference.

Application of Biology to Agriculture

Dr. Hubert Martin's presidential address to Association of Applied Biologists, delivered on Feb ary 12, 1943, which has now appeared in the *An of Applied Biology*, pays tribute to the work of Biology War Committee and expresses the view t the provincial advisers in the biological subjects soon be expected to assert their proper and powe influence on the activities of the War Agricult Executive Committees. Discussing the official re nition of proprietary pest control products, w has been brought into fresh prominence through participation of the advisory services in the "Gr more" campaign, Dr. Martin outlined the nego tions between the Association and the Bri Mycological Society, the Ministry of Agriculture the Association of British Insecticide Manufactu which had led to the scheme announced in Oct for a joint panel to give the requisite guidanc the advisory committee. The further growth of scheme, which will not admit products of w secret composition and which includes no te ganization, is dependent on the goodwill of those ncerned in its operation, and Dr. Martin regretted at no provision was made for the direct representa- n of the Association of Applied Biologists or of e advisory services on the organization.

In Dr. Martin's opinion, personal contact is the yal road to the full application of biology to agri- lture, but for the grower the printed or written rd is the best form of memorandum. After citing stances of the failure of the results of research to transmitted in proper perspective to the grower, . Martin commended to the Agricultural Improve- ent Council the appointment of a corps of intelli- nce or public relations officers. Such officers should journalists acquainted with both practical and entific aspects, able to translate research into vivid rkaday English, wise enough to avoid sensa- nalism and to seek expert advice on their scripts fore publication. To foster mutual confidence they ould move freely among growers, advisory officers d research workers.

sponsibilities of Scientific Societies

THE latter part of Dr. Martin's address is devoted the wider questions of the post-war responsibilities the Association of Applied Biologists, particularly presenting a common front with other scientific en to guide the application of science. Science, he id, must protect itself from exploitation and must o accept responsibility not only in safeguarding manity against such misuse, but also in ensuring at mankind shall profit to the full by the impact science. In furtherance of this, Dr. Martin suggested bdivision of the Society not on a geographical but a subject basis, each subject group dealing with e applied aspects of one particular branch of ology. The subject groups would then serve to k together all biological sciences in an organiza- n capable of exerting a unified pressure, yet bound t by rigid rule or order but by common interests d responsibilities. He believes such a method uld provide for collaboration with the academic cieties without necessitating the segregation of non- thological members of the Association in accordance th W. C. Moore's suggestion to the British Myco- gical Society. Moreover, it could also be made to rve the unification of science by counterbalancing e economic tendency of the larger publishing cieties to lose contact.

Discussing further the formation of a united entific front, Dr. Martin believes that this is more ely to be achieved with the publishing societies ther than the professional societies as the basis for organization. He visualizes a Science Council on hich the sciences would be represented by election m the publishing societies. Such a Council should, urged, set up a main committee with sub-com- ittees in the different sciences, which, with philo- gical representation, would extend the work on menclature to that of terminology at its broadest. s task would be to guide the evolution of language d to add to its precision as an instrument of science. e pleaded also for a simplification of spelling, but en more important than a common language is the sk of training humanity in those principles to which ience itself is dedicated. The primary task of the mmonwealth of Science is to convert mankind to e methods and ethics of science; to train the ung in the discipline of science; to instil into atesmen and politicians the spirit of science and to ow commerce that there is more profit in the full application of science than its exploitation. This would involve a fundamental change in the status of the sciences in education and a change in the attitude of the scientific hierarchy towards the political responsibilities of science. He thinks that the danger of fundamental science becoming neglected is illusory, but he deplored any industrial pressure which restrains publication of knowledge. Patent laws encouraging such restriction should be repealed. The danger of falling from scientific grace is no reason for monastic seclusion and for refusal to participate in building up a science front strong enough to withstand any form of pressure, or to correct political and industrial offences against scientific interests and principles.

The Lister Institute of Preventive Medicine

THE report for 1943 of the Lister Institute of Preventive Medicine marks the fiftieth anniversary of the beginning of its scientific work and records work of a quality which reflects great credit on Sir John Ledingham, who has recently retired from the directorship, and on all his staff. The war-time dispersal of some of the staff to other laboratories may have its disadvantages, but it must have brought advantages also through the closer contacts made with other workers. For thirty-eight years Sir John Ledingham has been a member of the staff of the "Lister", and thirteen years ago he succeeded Sir Charles Martin as director. These are two names respected by every man of science; they both call up the vision of indefatigable work devoted to the betterment of the lot of mankind, the vision of men who have never sought publicity, of strong personalities whose modesty has always been an inspiration to all who came into contact with them. It is good to know that both are still at work. Every scientific worker will wish to take this opportunity to add to their public honours his tribute to their generous comradeship with the younger generation, their continual output of ideas, assistance and more and yet more results of their own outstanding labours.

Diet of Wood Pigeons

THE recently issued sixth bulletin on wood pigeon studies being organized from the British Trust for Ornithology at Oxford contains some interesting observations of agricultural importance. The examination of nearly 4,000 wood pigeon crops suggests that, contrary to the general belief of farmers, wood pigeons do not eat the 'heart' or buds of clover plants; they eat the leaves and not the buds. Nor do they normally eat young corn but only the seed. During the mild winter of January and February 1943, wild fruits like ivy berries, haws and acorns were found in the 393 crops examined, whereas during the more normal winter of January and February 1942 (131 crops examined) the main food was shown to be cultivated clover. With the co-operation of phenologists a record is being made of the local variations in the abundance of acorn crops, because this seems to be the controlling factor for the movements of the wood pigeon flocks in Great Britain in winter. This might influence forestry work. The food habits of the smaller stock dove are shown to differ. This bird does not take the same food as the wood pigeon: it appears to be more of a ground-feeding species, living almost entirely upon cereals, weed seeds and roots. When the extra acres of woodland are scientifically managed after the War, they may attract the wood pigeon to feed there in the autumn instead of in the farm fields.

Poisonous and Harmful Fishes of Australia

G. P. Whitley has produced a most useful guide to all the poisonous and harmful fishes likely to be encountered in Australia, New Guinea and the islands of the south-west Pacific (Bulletin No. 159, Council for Scientific and Industrial Research. Commonwealth of Australia. Division of Fisheries, Report No. 10, 1943). This work will be useful to members of the Allied Forces who may be unfamiliar with the fishes of these regions, many of which, although attractive in appearance, are very poisonous if eaten, while others possess spines in connexion with poison glands which, if encountered, may cause great pain. The report is well illustrated by coloured and uncoloured figures, and the descriptions are written in non-technical language. Simple methods of treatment for food poisoning and for wounds from venomous fishes are included, and there are also hints for collectors who may wish to preserve specimens. A more detailed and technical work with full bibliography on the same subject is to be published shortly.

Mediterranean Culture

In his Fraser Lecture under this title (Cambridge: At the University Press. Pp. 52. 2*s.* net) Sir John Myres deals with a culture which developed in "an exceptional human habitat". He analyses first the permanent features of the mode of life of the ordinary dwellers in this Mediterranean area. Here is a peasantry closely adapting itself to the possibilities which the environment offered, and a wider community drawing from outside, since "in a region so physically uniform it was necessary to go far for anything unusual". Hence the significance of the sea, and with it sea-power shown legitimately in commerce, colonization, and pilgrimage, and otherwise in piracy. Hence, too, the gulf between the city, product of this sea-life, and the peasantry, a gulf that "has become an enduring fact of Mediterranean life"; and on all, immigrants have made their influence felt. Sometimes they have been "transformed by transit through the mountain zone", sometimes they have disorganized life for a time, but only for a time, since "the primary economic groups persist or re-appear". This summary analysis, to quote the author, "if not quite historical geography is offered as an essay in geographical history". Many will derive pleasure and profit from what is thus offered.

Inter-Allied Charter of Health

The Anglo-Czechoslovak Founders Committee is offering a series of prizes for the best essays on an Inter-Allied Charter of Health. The subjects for consideration in the essays are: (1) the study and survey of post-war relief schemes and other measures for health planning; and (2) the draft of a project to implement Article 6 of the Atlantic Charter with reference to health. A competitor may deal with these subjects separately or jointly. The competition is open to all medical men, public health experts, biologists and other workers in services connected with health. The minimum prize will be £30, the maximum to be determined later. The final date of entry is December 31. The Council for Education in World Citizenship, in collaboration with the Anglo-Czechoslovak Founders' Committee, proposes instituting a parallel competition in British and Allied schools in Great Britain. Further information can be obtained from the Health Charter Study Group, c/o Czechoslovak Institute, 18 Grosvenor Place, S.W.1.

Royal Society of Edinburgh: New Officers

At the annual meeting of the Royal Society Edinburgh held on October 25, the following offic were elected: *President,* Prof. E. T. Whittake *Vice-Presidents,* Dr. James Watt, Prof. T. H. Milr Sir John Boyd Orr, Dr. A. W. Greenwood, Prof. Hindle, Dr. D. Russell; *General Secretary,* Pr James P. Kendall; *Secretaries to Ordinary Meetin* Prof. R. J. D. Graham, Prof. W. M. H. Greave *Treasurer,* Sir Ernest Maclagan Wedderburn; *Cu tor of Library and Museum,* Dr. John E. Mackenzi *Councillors,* Dr. Robert Campbell, The Right H Lord Cooper, Prof. E. W. H. Cruickshank, Sir Donald Pollock, Mr. Stanley Cursiter, Dr. Doug Guthrie, Prof. J. W. Heslop Harrison, Mr. Andrew Young, Prof. E. T. Copson, Lieut.-Col. W. F. Harv Prof. A. E. Trueman, Prof. John Walton.

Announcements

The following doctorates of the University London have been conferred: *D.Sc.:* Mr. B. Ka of University College; Mr. H. G. Wells, an exter student; *D.Sc.(Eng.):* Mr. G. Hughes, an exter student; Prof. A. F. C. Pollard, University profes of (mechanical) instrument design, Imperial Coll of Science and Technology; *D.Sc.(Econ.):* R. G. D. Allen, University reader in statisti London School of Economics.

A discussion on "The Tetrapyrrolic Pigment will be held by the Biochemical Society on Novem 13, beginning at 11 a.m. The meeting will be h in the Department of Organic Chemistry, Imper College of Science and Technology, London, S.W Further particulars can be obtained from Dr. Robson, King's College, Strand, London, W.C.2.

The *Pharmaceutical Journal* has issued a pamph entitled "A Glossary of Terms used in Sex Hormo Therapy". The introduction explains that most the human hormones, excepting adrenalin, are eit proteins, protein derivatives or steroids, and a br description of the nomenclature of the steroids given. The Glossary will be useful to those w cannot make a special study of this field of wo and who have little time to find a way through t maze of names in hormone literature.

Manufacturers of insulin, in consultation w the Diabetic Association, have decided to standard the colour and style of the packings, so that in futu type and strength will be uniform irrespective maker. Steps have also been taken to elimin unnecessary deterioration in pancreas during tran from cold storage to manufacturing plant. T number of diabetics in Great Britain shows a yea increase, and is now estimated at 200,000, but th do not all take insulin. The Ministry of Supply sta that adequate supplies of insulin have been ensu both for the home market and for liberated countri

A million dollars has been set aside by the Cou for the Promotion of Science and Technology China as cash awards for solutions of natio defence scientific problems. The Council for Promotion of Science and Technology has selec ten special industrial and scientific problems consideration. Chinese men of science, industr technicians and research workers are invited engage in studies and research on these problems a submit reports of their results to the Council bef the end of the current year.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Localization of Chemoreceptivity in Drosophila

The outbreak of war brought to a standstill a programme of experimental investigations into the genetics of behaviour patterns among Drosophila mutants in the laboratory of the senior author of this note. The end in view was threefold : (*a*) to take advantage of structural modifications of putative receptor organs by mutation as a basis for exploring their functions ; (*b*) to gain knowledge of reproductive behaviour requisite to further investigation of assortative mating ; (*c*) to standardize the genetic variables affecting behaviour patterns as a basis for inquiries of either type. Recently it has been possible to make a fresh start. The object of this preliminary note is to indicate some positive conclusions about the localization of chemoreceptivity by study of the reactions of mutants with antenna defects or abnormalities, more especially *antennaless*, discovered by Gordon and Sang[1], and *aristapedia*.

The characteristic of the latter is replacement of a normal antenna by a leg-like appendage which, however, bears peg-like organs and other structures of supposedly receptive function present in normal antennæ but not in the normal leg. Full exhibition of the gene *antennaless* leads to complete suppression of both antennæ, partial exhibition to unilateral suppression. By varying the conditions of culture, Gordon and Sang[1] showed how it is possible to obtain genotypically homozygous antennaless individuals with no manifest somatic effect of the gene. Among flies of pure stocks we may therefore distinguish between what they respectively call *antennaless* (A_0) phenotypes, half antennaless (A_1) with unilateral exhibition and wild type antennaless (A_2), the latter being genotypically equivalent to the first two but phenotypically like ordinary flies. It is therefore possible to use as controls flies without antennæ genotypically identical with flies which have them on one side or both sides. Our experiments with these tocks include tests on their phototactic and geotactic eactions, their behaviour in a humidity gradient and heir response to solutions containing volatile contituents. This note deals only with results of the ast-named class.

As is well known, yeast culture and solutions containing ethyl alcohol acetic acid and various esters exert attraction for *Drosophila melanogaster*. A mixture ('M') containing baker's yeast, ethyl alcohol and traces of acetaldehyde, ethyl acetate, methyl acetate and butyric acid attract the flies more strongly than any single constituent. For that reason we have used it for trapping experiments essentially like those of Barrows[2]. The method was to release large numbers of flies in a chamber with traps containing M or water ('W') as a control. Results of a ypical experiment with antennaless stocks are in Table 1, showing the number of flies trapped as a percentage of the number of a given category released. O_r stands for wild type flies of Oregon stock.

TABLE 1.

Solution	Percentage of flies of each class trapped				Total of each group released
	A_0	A_1	A_2	O_r	
M	1	31·5	52·5	58·7	400
W	3	8	5	6·7	

TABLE 2.

	A_0—V_g	A_1—V_g	A_2—V_g	
M	4·5	46·4	98·2	112
W	0·0	1·0	0·0	

TABLE 3.

	SS^a	Y-V-F	F_t	
M	43·6	61·9	70·0	360
W	3·3	3·6	1·9	

Experiments with various mutants having structural defects of the wings leading to defective power f flight conclusively exclude the possibilities that the negative chemoreactivity of the antennaless (A_0) flies is not due to mechanical inability to reach the goal. From this point of view, experiments (Table 2) involving flies ($A-V_g$) homozygous for both the vestigial gene and for antennaless are sufficiently explicit.

A comparison between the behaviour (Table 3) of mutants, for example, *yellow-vermilion-fork* and *filamentless* (F_t) with normal antennæ and *aristapedia* (SS^a) shows that the macroscopic modification of the antennæ in flies of the last-named type does not eliminate chemoreceptivity, though diminishing it somewhat. The characteristic of the *filamentless* mutant control is absence of filaments ordinarily attached to the egg-case.

We have tested the main conclusions illustrated by such experiments with a new type of olfactometer to be described in a forthcoming publication. This device eliminates air flow, offering flies the choice between an exit leading to a chamber containing the attractive mixture and a control chamber with water. The results substantially confirm those of trapping released flies; but also show that total absence of antennæ does not *entirely* abolish receptivity to vapours.

Since microscopic examination of the leg-like antenna of *aristapedia* reveals the presence of the type of sensilla in the distal joint of the normal antenna, our results point to the conclusion that these organs are the chief olfactory receptors involved in the search for food. However, the peg-like organs of *aristapedia* are not the only morphological differentiæ which they share with a normal antenna in contradistinction to a normal leg ; and we are at present investigating the possibility of a more precise identification of the relevant structures by recourse to study of other mutants. Meantime, we have clear-cut evidence that olfactory receptivity of Drosophila, at least with respect to its as yet known chemoreactions, is located almost exclusively in the antennæ.

We acknowledge with appreciation financial assistance from the Rockefeller Foundation for renewal of work on these problems.

Michael Begg.
Lancelot Hogben.
Zoology Department,
University of Birmingham.

Oct. 6.

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[1] Gordon, C., and Sang, J. S., *Proc. Roy. Soc.*, B, 130, 151 (1941).

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Trypan Blue and Cell Migration in the Adrenal Cortex of Rats

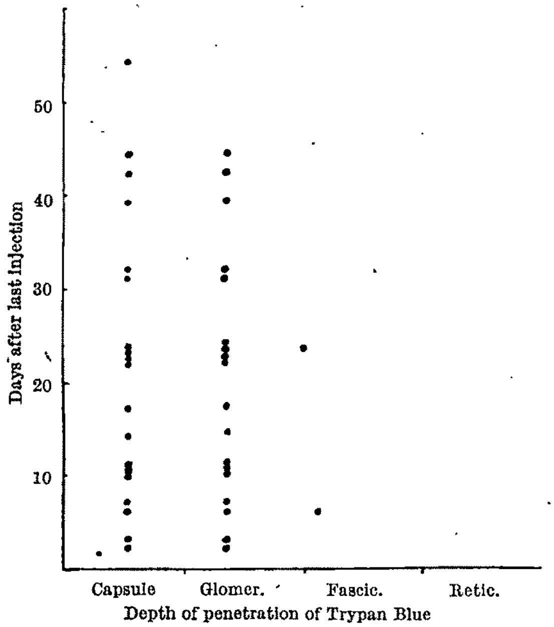
THE hypothesis has recently been put forward that there is an inward cell migration in the adrenal cortex. According to Zwemer *et al.*[1,2], in several species capsular cells multiply and move inwards, becoming in turn cells of the glomerular, fascicular and reticular layers. In guinea pigs Blumenthal[3] found that there is a zone of mitotic activity comprising the inner glomerular and outer fascicular layers, and Hoerr[4] found after chloroform narcosis increased mitotic activity in the outer fascicular layer.

Recently, Salmon and Zwemer[5] claimed that in rats Trypan Blue injected subcutaneously was first taken up by fibroblast-like cells in the capsule, and that afterwards dry droplets were to be found at varying intervals of time in the glomerular, fascicular and reticular zones successively, while the outer layers ultimately became free from the dye. On the basis of these findings they concluded that there was a progressive inward cell migration.

In the hope that this method might provide a reliable technique for the standardization of substances acting upon the cortex, we carried out similar experiments on seven batches, each of six male rats, some of the batches being composed of immature animals. The Trypan Blue was injected in doses of 1–3 c.c. of a 1 per cent solution in saline. The rats were killed 2–54 days after the last injection. Both glands were removed, and stained and unstained sections were examined.

In all sections examined, Trypan Blue droplets were present in the capsule, independent of the lapse of time after injection and the dosage given. Trypan Blue was also found frequently in the glomerular zone and very occasionally in the outer fascicular layer; but the depth of penetration of the dye bore no relation whatever, either to the time interval after the last injection, or to the dose given. The results obtained are plotted on the accompanying chart.

This method thus yields no evidence for centripetal cell migration in the adrenal cortex. The Trypan Blue uptake of the cells of the deeper fascicular and the reticular layers observed by Salmon and Zwemer may perhaps be due to the massive doses used (21–30 c.c. of a 1 per cent solution), which resulted in a generalized absorption of the dye by the whole cortex. It seems possible that the uptake of Trypan Blue and its subsequent appearance in droplet form in the fibroblast-like and glomerular cells is due to the macrophagic activity of the former and to some metabolic peculiarity of the latter, not normally possessed by the cells of the fascicular and reticular zones.



We would like to thank Prof. Samson Wright and Dr. J. H. Woodger for their interest and criticism.

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Amount of Heterochromatin as a Specific Character

ONE general fact which emerges from recent work in animal cytology is that the extent of the heterochromatic ('inert') segments of the chromosomes often varies very greatly from one species to another, even within the same genus. Thus, among the grasshoppers, *Stauroderus scalaris* possesses very large proximal heterochromatic regions in all the chromosomes, while in other species of the genus these regions are very much shorter and less conspicuous[1]. The same difference has long been known to exist between species of Drosophila, where *D. virilis* has the proximal half of each autosome heterochromatic, while in some other species such as *busckii* there is far less heterochromatin. These species belong to different subgenera; but it has recently been shown by Wharton[2] that *D. melanopalpa* has considerably more heterochromatin than the very closely related *repleta*. In the Pentatomids, Schrader[3] has shown that *Edessa irrorata* has prominent heterochromatic blocks at the ends of most or all of its chromosomes, which are not obvious in several other members o the same genus. An identical situation occurs in the Corixidæ, where Slack[4] has shown that *Corixa punctata* is a species with unusually extensive heterochromatin.

Since this phenomenon is clearly one of very widespread occurrence in animals (and possibly in plants as well) it seems desirable to have words to designate species with more or less than the average amoun of heterochromatin for the group to which they belong. I should like to suggest that species lik *Stauroderus scalaris, Edessa irrorata, Drosophila virili* and *D. melanopalpa* be called 'megaheterochromatic' the species with little heterochromatin being referre to as 'microheterochromatic'. It is unfortunately no always easy to distinguish between species in which the heterochromatic regions are long and those i which they are of average length but unusuall strongly heteropycnotic at certain stages of th nuclear cycle. It is believed, however, that all th examples cited do actually represent cases where th heterochromatic segments are unusually long, a though they may also be more strongly heteropycnoti than usual.

Heterochromatin, in all those forms where i functions have been analysed genetically, seems to be relatively, but not entirely, inert. That is to say, a heterochromatic region of a chromosome has fewer genes per unit length (as measured at mitosis) and these genes seem to be mostly ones the phenotypic effects of which are individually slight. Duplications or deficiencies of heterochromatic regions are likely to affect the viability of the organism much less than duplications or deficiencies of comparable length in the euchromatic segments. Thus the amount of heterochromatin may be expected to vary more from species to species than the length of the euchromatic segments. But this variation is clearly not haphazard and without significance, since in the megaheterochromatic species the increase of the heterochromatic regions usually seems to have taken place in a very egular and orderly manner in all the chromosomes. Heterochromatin seems to be an invariable constituent of every chromosome, that is to say, all chromosomes contain one or more heterochromatic segments, which may be long or short.

We unfortunately know very little as yet about he role of heterochromatin in the physiology of the cell ; but it is certainly bound up in an intimate way with the whole nucleic acid and protein-synthesis cycle. It is thus quite likely that general differences of a physiological nature may exist between megaheterochromatic and microheterochromatic species. The latter have seldom been studied in detail by cytologists, since it is the presence of conspicuous heterochromatic blocks (rather than their absence) which has attracted attention. Most of the authors ited above who have studied megaheterochromatic species were primarily interested in the phenomenon of non-homologous 'pairing' between the heterohromatic segments, that is, the fact that the ends of the chromosomes are stuck together at certain stages of mitosis and meiosis to form 'chromocentral' ssociations. This seems, however, to be merely incidental to the megaheterochromatic state.

It may be worth pointing out that a comparison between resting somatic nuclei from the same kind of tissue in a number of related species is usually quite sufficient to determine the amount of heterochromatin in a rough manner : in the megaheterochromtic species the chromocentral masses will be very much larger. Eventually, perhaps, we shall have some kind of quantitative index to express the mount of heterochromatin in a species ; at the moment all that seems necessary is a pair of terms to describe the extreme members of what is really a long series. Where heterochromatic supernumerary chromosomes are present in varying numbers in a species (as in the case of the B-chromosomes of maize nd the supernumerary X's of the bed bug[5,6]), this series exists within the species, so that we can distinguish between megaheterochromatic and microheterochromatic individuals. This is clearly an nusual situation, but an investigation designed to detect slight physiological differences between these individuals might throw considerable light on the more general problem of interspecific differences in the amount of heterochromatin present.

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Aqueous Soap Solutions of Carcinogenic Hydrocarbons

THE fact that carcinogenic hydrocarbons are insoluble in water has limited the means of administering them experimentally to the use of oily solutions or colloidal suspensions. In feeding experiments, it is a practical advantage to be able to administer substances dissolved in drinking water. Lorenz and Stewart[1] have used hydrocarbons dissolved in stable oil-in-water emulsions. Their method was adopted in some experiments in this laboratory. Where it is desired to achieve rapid absorption of a carcinogenic hydrocarbon from a mucous membrane or from the site of parenteral injection, an aqueous solution has obvious advantages.

Use was made of the mutual miscibility of ether soap and water to prepare aqueous soap solutions of several carcinogenic hydrocarbons. The following method was found to give good results : Up to 120 mgm. of 20-methylcholanthrene or 3 : 4-benzpyrene are dissolved in 10 c.c. of ether, and this solution is added to 50 c.c. of ethereal soap solution. This is the stock solution. Immediately before use, the stock solution is slowly mixed with as much water as is necessary to obtain the desired percentage of hydrocarbon and of soap. The ether is driven off by heating to boiling point. 1 c.c. of the ethereal soap solution used contains 1·8 gm. soap. To obtain a 0·01 per cent solution of hydrocarbon, 6 c.c. of stock solution is mixed with 120 c.c. of water, the percentage of soap being 7·5 per cent by weight. This strength has been used in practice. Fluorescence spectroscopy reveals identical bands for 3 : 4-benzpyrene in aqueous soap solution and in acetone.

After dilution with water, the hydrocarbon solution is at first quite clear, but opalescence gradually develops in the course of a few hours. Even so, the particles are much smaller than those of colloidal suspensions.

Rats show no aversion to drinking 0·01 per cent hydrocarbons in 7·5 per cent aqueous soap solution, and have showed no toxic effects after drinking it daily for six weeks.

After intravenous injection of such aqueous soap solution of 3 : 4-benzpyrene into mice, biliary excretion occurred in the same way as after similar injections of colloidal suspensions[2].

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Regulated Degradation of 1,3 Polysaccharides

IT has been shown[1] that when 1,4 polysaccharides, such as starch or cellulose, are treated with periodic acid solution, the carbon chain in each sugar unit is ruptured between carbon atoms 2 and 3, the —CHOH groups at these positions being oxidized to —CHO. Acid hydrolysis of these oxidized polysaccharides yields solutions containing glyoxal and erythrose. It has now been shown in this laboratory that aqueous solutions of periodic acid-oxidized starch or cellulose yield, when treated with phenylhydrazine acetate, a yellow amorphous precipitate. When the mixture is heated on the water-bath, glyoxalosazone is rapidly formed in crystalline condition. The glycosidic linkage, which is fairly resistant to acid hydrolysis, is thus readily opened by the phenylhydrazine reagent under mild conditions.

The interest of this reaction lies in the fact that it may be used to bring about a regulated degradation of 1,3 polysaccharides such as laminarin and the glucan of yeast membrane. It has been shown[2,3] that periodic acid oxidation of these polysaccharides affects only the non-reducing terminal sugar unit, by eliminating carbon atom 3 and oxidizing the $-CHOH$ groups at positions 2 and 4 to $-CHO$. Treatment of the oxidized polysaccharide with phenylhydrazine acetate brings about a rapid separation of glyoxalosazone, and the polysaccharide, the chain-length of which is now shorter by one glucose unit, may be readily recovered. The new terminal non-reducing unit may again be oxidized by periodic acid, and glyoxalosazone again eliminated on treatment with the phenylhydrazine reagent. In this way, the sugar units may be eliminated one by one from the non-reducing end of the polysaccharide chain.

The course of this degradative mechanism may be checked at intervals by oxidizing the $-CHO$ groups in the terminal unit to $-COOH$. The dicarboxylated end-group may then be assayed by neutralization (Barry[2]). The application of this method to yeast glucan, laminarin and other algal polysaccharides of the 1,3 type is at present being investigated in this laboratory. So far the degradation seems to be proceeding as outlined above, although in the case of the yeast glucan, there is evidence that it is halted after ten successive removals of glyoxalosazone. If this should be confirmed by repeated experiments, the failure to degrade the molecule further could be explained on the basis that one or more side-chains had been eliminated, leaving a closed loop of glucose units which now presents no point of attack to the periodic acid.

The reaction should also prove of value in detecting linkages other than those of the 1,3 variety in polysaccharides where the 1,3 linkage predominates. Where, for example, a 1,4 linkage is present, oxidation and subsequent treatment with the phenylhydrazine reagent should bring about a fragmentation of the polysaccharide chain with the production of oligosaccharides of shorter chain-length.

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Mid-dorsal Hair Whorls in Papuan Children

THE occurrence of hair whorls in the mid-dorsal region of man has been recorded in a high percentage of Australian aborigines[1,2], in a few Hawaiian fœtuses of mixed ancestry[3] and in one European[4]. Osman-Hill has observed the same anomaly in Veddahs[5].

During a spleen survey of native children in the village of Buna, in northern Papua, the dorsal hair whorl was observed in six out of eighteen children examined. In all cases the whorl was anti-clockwise in direction and centred over vertebral spines *D*4, *D*5, *D*7, *D*10 (each once) and *D*6 (twice).

The significance of this type of hair tract arrangement is obscure; its occurrence in this group of Papuan villagers extends its known range.

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Afterglow in High-Pressure Gaseous Discharges

THE persistence of luminosity after the interruption of an electrical discharge in certain gases at low pressures has often been observed, and the experiments on active nitrogen by Lord Rayleigh, and others[1,2], are well known. Dorgelo and Washington[3] have measured the persistence of metastable states in helium, neon and argon; Kenty[4], and Mohler[5], have studied the effect of electronic recombination in the afterglow.

The present experiments differ from those mentioned above in that newer methods of observation and high-pressure spark discharges are used. The results are of some practical interest in the field of high-speed photography.

Recurrent condensed spark discharges were used and the current/time relation for the discharges was accurately determined by means of a cathode-ray oscillograph. In all cases where the afterglow was more than about 5 microsec., the discharge current fell to a negligible value before the glow was extinguished. While it was difficult to prevent a very small current from flowing during the afterglow, such a current is clearly not the sole factor controlling the afterglows, which vary widely from gas to gas. The current/time relation is little affected by a change of gas for the same circuit conditions.

Figs. 1 and 2 are photographs taken with a rotating mirror camera; the time-scale is given with the figures. The hydrogen sparks, three of which are shown in Fig. 1, show no appreciable afterglow compared with argon (Fig. 2), although the spark channel, as would be expected, is wider and more sharply defined in hydrogen than in other gases. The rotating-mirror photographs for hydrogen could not be distinguished from stationary mirror photographs of similar sparks. Owing to the intense afterglow, and lack of boundary definition, the spark channel cannot be clearly distinguished in the argon discharge of Fig. 2.

The argon afterglow varies widely for different sparks in given circuit conditions. The records show that the afterglow is either uniform and wedge-shaped on the photographs, showing a greater persistence of illumination in the centre of the gap or is composed of a number of more or less separate luminous regions, of which at least four are shown in Fig. 2. It would appear, therefore, that the amount of light in the afterglow varies considerably from spark to spark, especially in the later stages of the discharge. A similar effect is obtained for long spark in air, as shown in the rotating-film camera record of Allibone and Meek[6], where again the persistence o exceptionally long afterglows at certain points in th discharge is apparent.

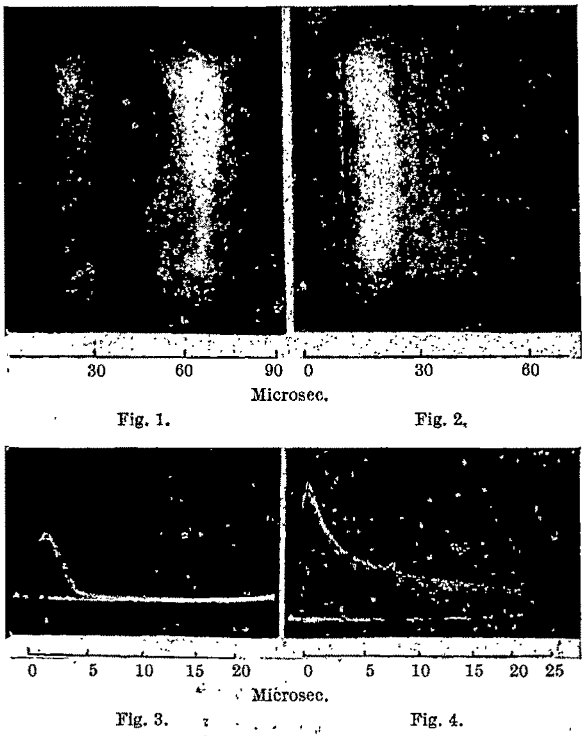

Fig. 1. Fig. 2.

Fig. 3. Fig. 4.

Discharges across point/point gaps (tungsten electrodes 1/16 in. diameter, with hemispherical ends) in 99·5 per cent hydrogen (0·5 per cent oxygen), Figs. 1 and 3: and in 98 per cent argon (2 per cent nitrogen), Figs. 2 and 4.

Fig.	Pressure (atmospheres)	Gap length (cm.)	Capacitance (mfd.)	Approx. circuit resistance (ohms)	Condenser voltage (kV.)
1	1·5	1·0	0·04	13	12·5
2	1·5	1·0	0·04	13	9
3	1·0	0·5	0·02	39	14·6
4	1·0	0·5	0·02	39	14·6

An electron multiplier was used to convert the light pulses from the spark into electrical pulses. Recurrent spark discharges were used, with the spark and the oscillograph time sweep triggered synchronously. The variable nature of the afterglow in argon is borne out in the oscillogram of Fig. 4, which shows the light output from some thousand sparks as a function of time. The intensity of light emitted in the early stages of the discharge is roughly the same for each spark, but there is considerable variation during the later stages. Fig. 3 is a comparable record of the light emitted by many sparks in hydrogen. In this case there is no observable difference in the light/time relation for the separate sparks. The results obtained with the electron multiplier therefore confirm the rotating-mirror records. The effect should be considerably enhanced by the use of a slit, arranged perpendicular to the spark channel. The amount of light passing through the slit to the electron-multiplier would probably then vary much more than the total amount of light for different sparks. It is, of course, the latter quantity that is measured in the experiments discussed above (Fig. 4).

After the electron-multiplier arrangement was devised, similar results with low pressure glow discharges in nitrogen were published[6] and brief references to the study of luminescence in solids, also using an electron-multiplier, have been found[7,8].

As both the electron-multiplier and the spark gap were enclosed in glass bulbs, little ultra-violet radiation from the sparks is recorded. However, the present results are intended only to show qualitatively the nature of the phenomena. In particular, it is important to check, more fully than has yet been possible, the response of the multiplier tube. Also it is hoped that, as circumstances permit, the work will be increased in accuracy and extended in scope to include measurements on the relative and absolute quantity of light emitted by spark discharges in various gases. The use of filters to study light of different wave-length ranges is also contemplated. It is hoped that detailed publications will appear in the future.

Another possible application of the technique, using an electron multiplier and an oscillograph, is the study of the development of the leader strokes which precede spark discharges. The time interval between the leader stroke and the main return stroke might be observed at different points in the gap with a higher degree of resolution than is possible with the rotating camera, where in some cases there is difficulty in distinguishing the leader stroke on account of the relative intensity of the main stroke if the camera speed is insufficiently high. Also, in rotating camera photographs the spatial width of the discharge can confuse the determination of the time relationship, and introduce appreciable inaccuracies even in cases where the camera speed is high enough to separate clearly the leader from the main stroke.

We wish to thank Dr. A. P. M. Fleming, director and manager of Research and Education Departments, Metropolitan-Vickers Electrical Co., Ltd., for permission to publish this note.

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Rugosity of Granular Solids

Now that the specific surface of a powder or granular solid can be quickly measured by the air-permeability method of Lea and Nurse[1] or by Rigden's simplification of the method[2], it has become possible for the first time to measure the average roughness and angularity, or 'rugosity' as we may call it, of the individual grains.

Rugosity we define as the ratio of the measured specific surface to the hypothetical surface area which the grains would have if they were all spherical. Wadell[3] recognized the value of this ratio or rather of its reciprocal, sphericity, but was unable to avoid a time-consuming method of measuring the dimensions of many individual grains.

Calculation of rugosity by the present more rapid method is based upon the determination of the specific surface and the particle size distribution. The first of these we measure by the air-permeability method of Lea and Nurse, the cell being modified for coarser particles into a longer and narrower tube; the second is measured by means of an accurately calibrated set of sieves, preferably in a mechanical sieving machine.

The coefficient of rugosity is expressed by the formula:

$$\frac{S_w}{\Sigma a_i . \pi d_i^2},$$

where S_w is the measured surface area of 1 gm. of material in C.G.S. units, a_i is the number of particles having a diameter d_i in the same mass (dimension $[M^{-1}]$), πd_i^2 is the surface of the hypothetical sphere made out of each particle, and the sum Σ represents the total surface of 1 gm. of this idealized material. Using the value w_i, the proportion of the mass in the i^{th} sieve fraction (dimensionless), we can write:

$$w_i = a_i \tfrac{1}{6} \pi d_i^3 \rho,$$

where ρ is the density of the material. We can also calculate a_i, which is:

$$a_i = \frac{6 w_i}{\pi d_i^3 \rho};$$

and from this we arrive at the coefficient of rugosity:

$$\frac{S_w \rho}{6 \Sigma (w_i/d_i)},$$

which is dimensionless.

It should be noted that a_i, used in the intermediate calculation, does not represent the actual number of irregularly-shaped particles, but the number of spheres that can be made out of each fraction keeping the experimentally determinable w_i and d_i correct.

An improvement can be made in the accuracy of the results if, instead of the actual sieve analysis figures, closer values are read from a frequency curve, which can be prepared by the graphical differentiation of the cumulative curve. Sieve sizes should be chosen so that not too high a proportion of the whole sample finally rests between two sieves.

The new method was developed in the course of work on the properties of synthetic steel moulding sands. It was found that two sands having the same specific surface, when mixed in the same way with the same proportion of water and 'Fulbond', a bonding material produced from fullers' earth, behaved quite differently in the green compression strength and plasticity tests. Microscopical examination showed that the grains of one of the sands were larger, rougher and more angular than those of the other.

The coefficients of rugosity of these silica sands are usually between 1·05 and 1·40, approaching unity when the grains are well rounded. The method is being applied by the Department of Refractory Materials, University of Sheffield, in the study of silica sands for use in synthetic moulding and core sands being conducted in conjunction with the Moulding Materials Sub-committee of the Iron and Steel Institute's Steel Castings Research Committee, and has yielded information of considerable value.

Coefficients of rugosity are likely to be valuable in the study of the flow properties of dry powders, and of the rheological properties of insoluble powder – liquid systems. It is a useful measurement for evaluating substances which are required to have a high specific surface combined with a high permeability to fluids, such as fullers' earth and base exchange materials. The method can probably be used for estimating the degree of aggregation of particles the separate particle size of which can be otherwise determined. So far the measurement has not been extended to particles which are platy or acicular, but a correction for particle shape could probably be made in the sieve analysis as suggested by Rittenhouse[4].

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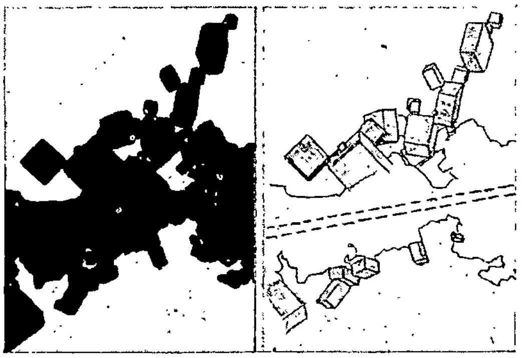
Electron Microscope Studies of the Capture of Air-borne Particles by Single Fibres

IN the course of some work with the electron microscope, studies have been made on the capture of small air-borne particles by single fine fibres.

In the accompanying illustration, *a* is the electron microscope picture (× 1900) of a collection of fine sodium chloride crystals clinging to a fine rubber fibre. Sodium chloride solution had been sprayed with an atomizer into air which was drawn past the fine fibre. The dotted line in *b* indicates the size of the fibre, which was approximately 0·7 mμ in diameter.



a *b*

The negative from which this print was made was projected on a wall screen so as to give an image considerably larger than the accompanying figure, and the apparent boundaries of the individual crystals were sketched on the screen; *b* is a photograph[1] of the resulting drawing, and gives a very interesting picture of the way crystals are caught and packed together.

This work was carried out in the course of experiments done by Dr. Beatrice Deacon, Dr. L. T. Newman and Dr. J. H. L. Watson; this particular experiment was done by the last-named.

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AN INTERNATIONAL INFORMATION COUNCIL[*]

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VALUABLE information on a subject is frequently scattered outside the recognized field of that subject and may appear in unexpected types of literature, as illustrated by the classical example of Mendel's two papers on his famous laws governing the inheritance of characters in plants and animals, which lay in obscurity for thirty years, and the remarkable French patent specification of Penaud and Gauchot of 1876 describing the modern aeroplane in detail, which was not brought to light before 1916.

Extensive search is necessary to gather all the available information on any subject, and the magnitude of the searching and sifting process is beyond the capacity of individual information services. Moreover, most services entirely neglect certain kinds of literature, such as university theses, patent specifications and trade literature, all of which are essential material for particular groups of people. Some services, however, recognize the importance of such literature. The Mellon Institute and the Carnegie library at Pittsburg, for example, have formed large collections of trade literature indexed by subject and name of firm.

The vast task of indexing the current literature alone could only be carried out by a carefully planned international organization by which the contents of all non-fiction literature were analysed, classified and recorded in the form of a simple bibliographical reference, as distinguished from a compound reference in which the simple reference is compounded with notes or an abstract. For the smooth working of the plan to be described, it is essential that these simple bibliographical references should be subject-classified by a standard international code, such as that known as the Universal Decimal Classification now in course of publication as a British Standard by the British Standards Institution, and prepared in a standard form which will shortly be published by the same body.

Bibliography is the work of specially qualified people. Usually the research worker, in whatever domain of learning he may work, is not qualified for bibliographical research, and in any event is denied the facilities open to the professional bibliographer. The intrusion of such work into his otherwise occupied time is resented, and in consequence his references are fragmentary and exert an undesirable influence upon the quality of his output. It was necessary to organize groups of specially qualified persons to analyse and classify man's priceless inheritance of recorded knowledge in order to make full use of it for the benefit of mankind.

In the international organization proposed, a supreme body, the International Information Council, is linked to national information committees situated in the literature-producing countries of the world, and under each national committee a family of national information bureaux carry out the work of recording the contents of the national literature. The essential feature of the plan is that the national information organization of a country shall deal exclusively with the literature produced in that country.

The organization is intended to serve government departments as well as the public, and the bodies composing it should be governmental or semi-governmental bodies subsidized by government funds. The bureaux under the national information committee of a country would deal with specific domains of the national literature, such as those concerned with general works, science and technology, agriculture, medicine, fine arts, philosophy, theology, sociology and law, commerce, languages, literature, history, etc.

The organization, in fact, is somewhat similar to the system of the Executive Council of the Imperial Agricultural Bureaux, with its twelve sections each concerned with a branch of science bearing on agriculture, which according to the report of the British Commonwealth Science Committee of March 29, 1943, ". . . has since its inception in 1929 been an outstanding success in providing a vital service, collecting, collating, and disseminating information on agricultural research to workers throughout the Empire and the world. The fact that this organization, administered by a constitutional and representative executive council sitting in London, has been continuously supported since 1929 by the whole Empire on the basis of an agreed contribution, surely implies that governments would be sympathetic towards an extension of such a scheme to other essential scientific services".

The personnel of the International Information Council should include representatives of the national information committees, and the personnel of each national information committee should include representatives of its bureaux, which consist of information officers fully qualified to deal with the literature of their respective subjects.

Assuming that the standard methods of preparing simple bibliographical references and the standard classification have been internationally adopted and that the world organization is in operation, current literature would be dealt with in the following manner. A list of the national material, as and when published, is obtained by the national information committee from the national library enjoying the rights of legal tax, or failing that from publishers' catalogues and other sources. The documents are obtained and roughly classed by the standard classification numbers and distributed to the bureaux. If the bureaux are assigned the classification numbers of their subjects, the distribution by means of these 'bureau numbers' becomes automatic. But some of the documents received by a bureau may contain 'unwanted' matter; in this case it is roughly classed and sent to the correct bureau for action. The bureaux prepare the MSS. of the references, which are printed on the international standard card, by the national committee. Copies of the cards are then distributed by the bureaux to their opposite numbers in other countries by means of air transport, in order to reduce the time of distribution to a minimum. It will be noted that in this process of distribution, it is not necessary for analogous bureaux in the different countries to have precisely the same bureau numbers, since it is only the bureau numbers which are the instruments of selection.

In this way each bureau will accumulate those references to the current literature of the world concerning its specific domain of information, and will build up a classified subject, or more correctly an 'ideological' card repertory of simple bibliographical references, which can be filed in duplicate to form an author, title, or generally an 'onomastic' card repertory.

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[*] Substance of a paper on "A Plan for Mobilizing Bibliographical References to the Contents of the World's Non-Fiction Literature" read at a meeting of the British Society for International Bibliography on September 28.

Non-current literature could be gradually dealt with in the same way by systematic reference to accession lists and union catalogues. The records for the non-current literature of a country would take many years to complete, but it is important that the current literature should be attacked as soon as possible before the growing mass gets beyond human control.

By an extension of the exchanging process to the national committees, a great central repertory of all information could be formed, but the enormous mass of references which would accumulate and the space required for storage would make such a proposition impossible to entertain, even if any advantages could be gained by having such a colossal and central national repertory. Each bureau must necessarily be established at an information centre where the material and the card repertories may be stored for use by the information officers and the public.

The application of this proposed organization to British bibliography might be made in either of two ways. The countries of the Empire may be regarded either in the geographical sense, each with its own national committee and family of bureaux, or the whole British Commonwealth may be grouped under one national committee, which might be called the British Commonwealth Information Committee. With this arrangement the bureaux probably would function as successfully as the twelve branches under the Executive Council of the Imperial Agricultural Bureaux.

Suitable British information centres should be government and public institutions in London, such as the libraries of the Science Museum—for the bureau or bureaux dealing with science and technology—the Victoria and Albert Museum, the Public Record Office and so on. Other libraries and institutions in different parts of the country should be authorized to obtain copies of any desired domains of the official card repertories, so that the records could be dispersed over the country for the benefit of the nation.

The organization is thus fundamentally concerned with the analysis and classification of information in the form of simple bibliographical references. Other services such as abstracts, progress reports, the provision of photo-copy, translation, special bibliographies on demand, loan services, etc., should be regarded as services outside the activities of the official international organization. Many of these services are in vigorous activity and obviously should be improved and developed by the use of the complete records filed in the card repertories of the official organization. It is stated in the report of the British Commonwealth Science Committee, to which reference was made above, that "The case for collaboration in the production of scientific abstracts of high quality for the common use of the English-speaking world is very obvious, and would have the strong support of the Committee". If the major abstracting services would agree to collaborate and adopt a method of passing on 'unwanted' matter to the appropriate service, in a manner similar to that described for material 'unwanted' by the official bureaux, the case might be made. The official card repertories unquestionably would greatly assist the abstracting services and help to avoid duplication more especially if each abstracting service was identified by classification numbers.

This immense international organization with its bureaux all over the world could not, of course, be established in its entirety in the first instance, but there appears to be no reason why the plan should not be initiated by the establishment of an Anglo-Soviet-American organization, primarily concerned with British, Russian and American current literature. The literature of other countries could be divided by agreement among the three members of the United Nations, and the work undertaken for any country in this way could be handed over as soon as its national information committee with the necessary bureaux had been established by the assistance of the International Information Council.

X-RAY ANALYSIS GROUP OF THE INSTITUTE OF PHYSICS

FOR some time past the need has been felt for closer co-operation between the users of X-ray diffraction methods. In industry, for example, many new applications are being found for these methods and their simplicity and directness make them valuable additions to industrial testing procedure Their use may sometimes be entirely empirical, but a sound understanding of the theoretical basis is necessary in order that the practical worker shal both recognize the limitations of his methods and be able to tackle the more unusual problems that are bound occasionally to be presented to him. It is desirable, therefore, that there should be some means for the technician to become acquainted with the latest results of theory, and for academic circles to learn of the problems that X-ray analysis is being called upon to solve.

The need has been partly met by the X-ray Conferences of the Institute of Physics, which were held in Cambridge in 1942 and 1943. Though their support, both from industry and from the universities was evidence of their success, the Board of the Institute has realized that such conferences can be of only limited value, and has now authorized the formation of an X-ray Analysis Group.

Despite its connexion with the Institute of Physics it is not intended that the membership should be confined to physicists. Since the formation of the Group has been sponsored by the Institute, the present committee has a strong bias on the side o physics, but it is hoped that it will become more truly representative of the different branches o science as vacancies in it are filled by election.

The inaugural meeting of the Group was held on Saturday, October 16, in the Physics Departmen of the University of Manchester, at the invitation o the Manchester and District Branch of the Institute Dr. F. C. Toy was in the chair. The papers read illustrated very well the objects for which the Group was formed.

The main lecture was given by the chairman o the Group, Sir Lawrence Bragg, on "The Physical Optics of X-Ray Analysis". Sir Lawrence emphasized the essential similarity between the diffraction o light by a grating and of X-rays by a crystal, and showed how the same principles can be applied to both. He spoke rather regretfully of the tardiness with which the mathematical theory of diffraction has been applied to X-ray problems and said that, now that the theory has been worked out, it is essential that those who use X-ray diffraction methods should make themselves acquainted with it; the 'Bragg Law' does not contain the whole of the subject.

Sir Lawrence then described the fundamentals of the theory of X-ray diffraction and the essential part that Fourier series play in it. He described how one is led to the concept of the 'reciprocal lattice' and explained, by reference to line gratings, how the theory can be used for the study of crystals deformed in different ways. Finally, he showed how appreciation of the similarity of the diffraction of X-rays and light can help in devising practical methods for crystal analysis. He described an apparatus for observing diffraction at small angles, and showed how it can be used for determining directly the intensities of a zone of reflexions given by the projection of any postulated structure. It can also be used for observing the diffraction pattern given by a single molecule or unit of pattern, and there are thus possibilities of working out structures completely by this means. Great advances may be expected when it becomes possible to work out these methods in greater detail.

After an interval for tea and for the inspection of the exhibition that had been arranged, four short papers on industrial applications were read.

Mr. C. W. Bunn, of Imperial Chemical Industries, Ltd., Northwich, showed some cinematograph films of growing crystals. These provide a great deal of evidence of the manner in which crystals are formed, and Mr. Bunn emphasized that there is still no complete explanation of all the phenomena observed.

Dr. A. H. Jay, of the United Steel Companies, Stocksbridge, described some results he has obtained on the correlation of the crystal structure, hardness and magnetic properties of some iron – chromium – nickel alloys. The face-centred cubic structure changes partly to body-centred cubic when the alloy is drawn into wire, and the changes of structure and hardness can be followed across the section of the wire.

Dr. I. MacArthur described the rotating anode X-ray tube in use at the Textile Physics Laboratory, University of Leeds. This tube differs from others in the smallness of the power it uses; the great efficiency is due to the fineness of its focus. That this is an important factor was shown by slides in the lecture and by prints in the exhibition; for example, there were fibre photographs taken with an exposure of less than a minute that would have taken hours with ordinary apparatus (see NATURE, July 10, p. 38).

Finally, Mr. L. D. Brownlee, of the Metropolitan-Vickers Electrical Company, Ltd., Manchester, described the use he has made of X-rays in the study of sintered carbides used for tool-tips. The subject is peculiarly suited to X-ray examination, and the information that has been obtained about the equilibrium diagrams of the components has proved extremely useful in understanding the nature of the reactions involved in the process of manufacture.

A lively discussion of the various papers followed. The interest shown and the attendance of nearly three hundred people at the meeting augur well for the future of the Group and of X-ray analysis in general. Further particulars about the Group can be obtained from Dr. H. Lipson, Crystallographic Laboratory, Free School Lane, Cambridge.

THE FREEDOMS OF SCIENCE

An address on "The Freedoms of Science" was given by Sir Robert Watson-Watt at an open meeting organized by the North-West Area of the Association of Scientific Workers in the Manchester College of Technology on October 18.

Sir Robert said that the demand for more central planning of science comes from people with a passionate sense of social responsibility. This demand has produced fears and fairly widespread opposition, some of which came from distinguished men of science of undoubted sincerity. There is a gap between these points of view, and he believes that it is both narrow and narrowing. The classical definition of science as organized knowledge is confusing, because it suggests a wholly artificial separation between pure science and technology. In Sir Robert's opinion, civilization began in technology, and pure science arose later when technology had made possible the leisure necessary for its pursuit; but to-day the applied scientist uses the same strict criteria of accuracy and logical evaluation as does the pure scientist.

Considering the position in the universities, Sir Robert maintained that pure science is already subject to planning. In addition there is a strong element of industrial planning; industrial undertakings make subventions to university departments. By whatever means a university is financed there is some form of budgetary control, and this control should be planned.

Sir Robert said he had discovered no debate about the need for some measure of planning in the application of science in war-time, but planning in hope for peace is nobler and more productive than planning for war through fear. One of the benefits of technology is to remove drudgery, but unless its application is planned, the result will be unemployment. A large part of scientific effort should be diverted to present needs, but pure science should also receive adequate provision. The facilities which the planners demand for pure science are on a scale which, rather curiously, is vastly greater than the 'freedomists' feel to be necessary. No 'direction' of labour in the scientific world is envisaged. The individual man of science must have the freedom to learn, think, choose, work and speak, but must never claim freedom from self-explanation, external criticism and social responsibility. There is a danger from overplanning, but it is slight. A potential Newton might remain mute and inglorious, submerged in a routine technological process, but that is unlikely to happen.

The kind of planning Sir Robert desired would provide for the free exchange of information. Some very successful planning bodies have been set up during the War, and could be copied in times of peace. The structure should be wholly democratic, and should enable the user to meet the research worker and state his requirements, and the research worker to explain what is and is not practicable. It would be necessary to bring the young bench-worker into the council chamber occasionally for this purpose. The planning of science is obtainable easily, smoothly and productively, and without danger to the freedom of fundamental science.

During the discussion, Prof. M. Polanyi said that, unlike Sir Robert, he believed that pure science should not be confused with technology. The search for organized knowledge, he said, cannot be planned, and it would be disastrous to attempt it. If pure scientists were diverted from their present work to something else, the work they are doing must suffer. If no such diversion is contemplated, it is unnecessary to raise the question of planning. He realized that such diversion is necessary in time of war or great emergency, but we should never lose sight of the implications of such proposals. One speaker suggested that this difficulty could be overcome by training more scientific men.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Saturday, November 6

Nutrition Society (at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1).—Conference on "Post-War Nutritional Relief".

Society of Chemical Industry (Glasgow Section) (joint meeting with the Scottish Group of the Nutrition Society) (at the Royal Technical College, 204 George Street, Glasgow), at 2.30 p.m.—Discussion on "Diet in relation to Industrial Health".

London Scientific Film Society (at the Imperial Institute Cinema, Exhibition Road, South Kensington, London, S.W.7), at 5 p.m.—Coal; VIEM; Pavlov Experimental Farm; Neuropsychiatry.

Monday, November 8

Royal Geographical Society (at Kensington Gore, London, S.W.7), at 8 p.m.—Dr. Douglas Guthrie: "Greece and Aegean Islands" (with Kodachrome Films).

Tuesday, November 9

Society of Chemical Industry (Chemical Engineering Group) (joint meeting with the Manchester Section of the Society and the Institution of Chemical Engineers) (at the College of Technology, Sackville Street, Manchester 1), at 2.30 p.m.—Major V. F. Gloag and Mr. R. J. Barritt: "The Manufacture of Sulphuric Acid in Contact Plants".

Institution of Civil Engineers (Railway Engineering Division) (at Great George Street, Westminster, London, S.W.1), at 5 p.m.—Mr. C. E. Fairburn: "The Electrification of the Wirral Lines of the L.M.S. Railway".

Royal Institution (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Sir Henry Dale, G.B.E., P.R.S.: "Progress in the Treatment of Infections", 2: "The Beginnings and Growth of Chemotherapy".*

Wednesday, November 10

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. P. R. Morris: "Education To-day and To-morrow", 1: "English Education As It Is".

Society of Chemical Industry (Food Group, Microbiological Panel) (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 2 p.m.—Dr. J. Ramsbottom: "Fungi as Food".

Physical Society (Colour Group) (joint meeting with the Technical Section of the Paper Makers' Association of Great Britain and Ireland) (at the Connaught Rooms, Great Queen Street, London, W.C.2), at 2.30 p.m.—Mr. S. R. H. Edge: "Colour Measurement for Control and Research in Paper Making".

Chemical Society (joint meeting with the Glasgow University Alchemists Club and the Andersonian Chemical Society) (in the Chemistry Department, The University, Glasgow), at 3.30 p.m.—Prof. John Read, F.R.S.: "Humour and Humanism in Chemistry".

Royal Meteorological Society (at 49 Cromwell Road, South Kensington, London, S.W.7), at 4.30 p.m.—Papers.

Wednesday, November 10—Thursday, November 11

British Coal Utilisation Research Association (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1).—Conference on "Problems in the Utilisation of Small Coals".*

Wednesday, November 10

At 2.30 p.m.—"The Utilisation of Small Coals and Slurries".

Thursday, November 11

At 10 a.m.—"The Utilisation of Fuels of High Inert Content".
At 2.30 p.m.—"The Upgrading of Fuels".

Thursday, November 11

Chadwick Public Lecture (at the Royal Sanitary Institute, 90 Buckingham Palace Road, London, S.W.1), at 2.30 p.m.—Mr. J. H. Forshaw: "Town Planning and Health" (Bossom Gift Lecture).*

Royal Institution (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir James Jeans, O.M., F.R.S.: "The Methods of Modern Astronomy", 2: "Photographic Astronomy".*

Royal College of Surgeons of England (at Lincoln's Inn Fields, London, W.C.2), at 3.15 p.m.—Mr. H. S. Souttar: "Physics and the Surgeon" (Bradshaw Lecture).

Society of Chemical Industry (Newcastle Section) (joint meeting with the Royal Institute of Chemistry, Chemical Society, and Oil and Colour Chemists Association) (in the Lecture Theatre, King Edward School of Art, King's College, Newcastle-upon-Tyne), at 6 p.m.—Mr. I. W. A. Kirkwood and Dr. P. D. Ritchie: "Plastics"

Pharmaceutical Society (at 17 Bloomsbury Square, London, W.C.1), at 7 p.m.—Mr. M. A. H. Tincker: "The Use of Plant Growth Substances".

Friday, November 12

Royal Entomological Society of London (joint meeting wi the British Ecological Society) (at 41 Queen's Gate, Sou Kensington, London, S.W.7), at 2.30 p.m.—"The Inter-relations Plants and Insects—the Place of Both in the Eco-System" (Speake Prof. E. J. Salisbury, F.R.S., Dr. E. A. Cockayne, Capt. Cyril Div and Dr. C. F. C. Beeson).

Royal Institution (at 21 Albemarle Street, London, W.1), 5 p.m.—Dr. C. D. Darlington, F.R.S.: "The Origin of Cultivat Plants".

Chemical Society (in the Chemistry Lecture Theatre, The Univ sity, Sheffield), at 5.30 p.m.—Prof. N. K. Adam, F.R.S.: "Surfa Films".

Chemical Society (joint meeting with the University Colle of Bangor Chemical Society) (in the Chemistry Lecture Theat of University College, Bangor), at 5.30 p.m.—Prof. M. Polany "The Strength of Carbon Bonds".

Institution of Mechanical Engineers (at Storey's Gate, S James's Park, London, S.W.1), at 5.30 p.m.—Mr. W. E. Ballar "Reclamation of Worn Parts by the Metal Spraying Process"; M W. Andrews: "Building-up and Hard-Surfacing by Welding' Mr. A. W. Hothersall: "The Repair of Worn or Over-machin Parts by Electro-Deposition".

North-East Coast Institution of Engineers and Shipbuilde (at the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—I T. H. Havelock, F.R.S.: "The Approximate Calculation of Wa Resistance at High Speed"; Dr. J. Lockwood Taylor: "Pressu Distribution on Propellers".

Saturday, November 13

Biochemical Society (in the Department of Organic Chemistr Imperial College of Science and Technology, South Kensington, Lo don, S.W.7), at 11 a.m.—Discussion on "The Tetrapyrrolic Pigments

At 11.15 a.m.—Prof. D. Keilin, F.R.S.: "Properties and Functi of Natural Tetrapyrrolic Compounds".

At 12.10 p.m.—Prof. H. Munro Fox, F.R.S.: "Varieties Hæmoglobin".

At 1.45 p.m.—Mr. R. Hill: "Tetrapyrrolic Compounds in Plants

At 2.35 p.m.—Dr. E. R. Hartree: "The Constitution of Catalase

At 3.15 p.m.—Mr. J. R. P. O'Brien: "The Metabolism of Bloc Tetrapyrrolic Pigments".

At 4.30 p.m.—Dr. C. Rimington: "The Porphyrinopathies".

APPOINTMENTS VACANT

Applications are invited for the following appointments on before the dates mentioned:

Deputy City Surveyor and Engineer—The Town Clerk, Tow Hall, Manchester 2 (endorsed 'Deputy City Surveyor and Enginee (November 10).

Two Science Masters (or Mistresses) to share the teaching Chemistry and Physics in the Wellingborough Grammar School Higher School and Scholarship standard—The Secretary for Educ tion, County Education Offices, Northampton (November 11).

Transport Manager and Engineer—The Town Clerk, Tow Clerk's Office, Tonbridge Road, Maidstone (November 12).

Team Leader for Entomological Work in connexion with schen of the Ministry of Agriculture for Pest Control—Prof. R. G. Whit School of Agriculture, University College of North Wales, Bang (November 12).

Graduate Assistant Master with special responsibility for th Technical Department (a Physicist with ability to teach Mathemati is being sought, and preference will be given to candidates with son knowledge of Engineering and/or Industrial Experience)—The Princ pal, South Dorset Technical College, Newstead Road, Weymout (November 12).

Educational Psychologist (part-time) to undertake work at tl Chislehurst Child Guidance Clinic—The County Medical Office County Hall, Maidstone (November 13).

Lecturer in Physics (graduate with, preferably, high qualific tions in Physics, and able to teach classes in Elementary Mathematic —The Director of Education, The Polytechnic, 309 Regent Stree London, W.1 (November 15).

Lecturer in Mechanical or Production Engineering Subjec up to Higher National Certificate standard in the County Technic College, Wednesbury—The Director (H), County Education Office Stafford (November 15).

Assistant (temporary) in the Department of Geography- The Registrar, The University, Leeds 2 (November 15).

Laboratory Technician (must hold Certificate of Institute Medical Laboratory Technology, or its equivalent, and have co siderable experience in Biochemistry)—The Medical Director "R.2' Staines County Hospital, Ashford, Middlesex (November 18).

Technicians (highly skilled in Bacteriological and Serologic Venereal Disease technique) for a Bacteriological Laboratory—Tl Town Clerk, The Guildhall, Nottingham (November 20).

Professor of Engineering—The Registrar, University Colleg Singleton Park, Swansea (November 20).

Assistant (temporary) to teach Mathematics and other Juni Engineering Subjects—The Principal, County Technical College an School of Art, Newark, Notts. (November 22).

Psychologist (with an Honours Degree in Psychology, experienc of testing, remedial teaching, and preferably child guidance work)- The Medical Superintendent, Central Mental Hospital, near Warwic (December 4).

City Engineer and Surveyor—The Town Clerk, Town Clerk Office, St. Albans (endorsed 'City Engineer') (December 10).

College of Science
PHYSICS Dep
92, Upper Circular Rd, Calcutta

NATURE

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EDUCATIONAL RECONSTRUCTION (6)

SCIENCE AS AN EDUCATIONAL DISCIPLINE

THE recent publication of the White Paper on Educational Reconstruction, the Norwood Committee's Report on the Curriculum and Examinations in Secondary Schools, and the several other reports relating to the same or similar themes, together with the large number of articles already published commenting chiefly on the first two important publications, have raised once again the all-important question of the place that science is to take in future education.

Many of these pronouncements still betray a strange lack of appreciation of what science has to offer, and, indeed, of what science really is. Too many educationists, and, in fact, too many other men of science, still think of it as little more than weighing and measuring, laboratory and test tube. This is reflected in the science syllabuses of most of our schools of to-day—especially secondary. No doubt the ever-present vicious circle inspired by the examination system—school, university, school—is responsible for much of this, and until the whole examination system receives the long overdue drastic revision now so desperately needed, the 'subject' bogy will continue to baulk the efforts of the most ardent and authoritative reformers.

In this respect perhaps the universities are more to blame than the schools. While the former persist in retaining their rigid division into faculties and departments with so little collaboration, exchange of ideas and pooling of effort among themselves, so must we tolerate the present artificial division of our school curricula into 'subjects'. Most of our teachers must inevitably leave the university having graduated in two to four subjects. In these subjects one assumes they are comparatively well read, but outside these subjects one is equally justified in assuming that most of them know little or nothing. During their academic careers, the demands of their own university examination system have made it impossible for them to spare much time for anything but their degree subjects. Then afterwards, the school examination system almost precludes even the most progressive teacher from straying very far beyond the syllabus dictated by the requirements of the examinations.

A proposal is being made by the British Association Committee on Post-War University Education which should go far in helping to remove this serious blemish on our system of training teachers (see NATURE, **150**, 716; 1942), and it is to be hoped that the Board of Education Committee on the Training and Supply of Teachers is taking due note of this. Meanwhile, science in our secondary schools still largely comprises the subjects of physics, chemistry and biology (and in many cases not even the last-named) to the exclusion of all other aspects of science, except, in some cases, in the lower forms.

Furthermore, the attitude of the schools to the above three subjects alone is all too frequently based on traditional beliefs and premises which should have been discarded long ago. For example, it should not have been necessary for the Women's Engineering Society at its recent annual conference to deprecate the fact that in the education of girls insufficient emphasis is laid on the teaching of physics and applied mathematics. The statement is a true one, and the Society's complaint justified. The reason for this complaint coming from such a Society is clear, but its implication is an indictment of our educational system. The fact that girls do not study enough physics and applied mathematics is really a relative one, for which there is neither rhyme nor reason. Through the past several decades girls have studied more of the biological sciences (until recently, botany only) and less of the physical sciences, and the boys vice versa. It is probable that this was due to the very narrow view of science in education then held—namely, utilitarian; in after-life boys would not need biological knowledge and girls would not need physical knowledge. The trend is away from this to-day, but the schools still have a long way to go. Once science is accepted as something more than a vocational discipline, then this false emphasis on certain aspects of science, this baseless differentiation between boys and girls, will disappear once and for all, though certain rational distinctions must be recognized.

There is very little direct reference to science in the White Paper on Educational Reconstruction. This, of course, is to be expected, since the White Paper is not concerned to any great extent with syllabuses, though its proposals will certainly affect them. It is to be hoped, for example, that when the large number of new school buildings are being planned, reasonable scope will be allowed for the demands of science—buildings, laboratories and equipment. This is not asking too much provided a comprehensive, and therefore reasonable, view of science as a school discipline be taken. It does not imply costly equipment, neither does it imply large and expensive laboratories. In fact, even if funds were available, both should be discouraged. To-day, with science teaching organized as it is and with the examination system dominating secondary school education as it does, too much time is spent in laboratory and other practical work. This is probably due to the fact that we still tend too much towards science as a vocational subject. True, the vocational aspect is of outstanding importance and will be even more so in the proposed new technical schools. There the more utilitarian sciences will demand much of the pupil's time, and laboratories and equipment will be very necessary adjuncts to the science teacher.

One feels somewhat discouraged even so far as this is concerned when one realizes the amount of money which the White Paper proposes allocating for the purpose of technical education (see NATURE of November 6, p. 517). The Education Committee of the London County Council has also deplored the lack of provision in the White Paper for a much greater rate of progress in the development of technical education.

But science also has its cultural aspect, and here educationists and educators of the future will have to broaden their views and consider the important aspects of science which are not directly vocational, but have an important part to play in cultural training and training for citizenship. Such aspects of science are, for example, the social implications of science, the history of science, and so forth. Until quite recently, most secondary schools where biology was taught merely gave a brief survey of the plant and animal kingdoms; almost invariably man was excluded. Now the social implications of biology are being more and more emphasized in, for example, health education. The Central Council for Health Education has for some time pressed for biology in schools to be used as a background for health education, and one could with profit go still further, using this so-called 'subject' as a basis for the elementary study of vital statistics, population problems, population movements, and so forth.

The cultural aspect of science will find a greater place in the newly proposed grammar schools and also in adult education. Experience in lecturing to adult audiences (at present chiefly in H.M. Forces) shows that there is a very keen demand for the study of science in so far as it affects man and mankind. This is, of course, in addition to the demand for vocational training. The latter should not take a very high place in the new senior and grammar schools.

All teachers, in schools and universities, bear the responsibility of transmitting the traditions of our civilization, and when science is being taught the teachers cannot help having its obligations in their minds, and those obligations must be taken into account. Science has made, and is still making, exceedingly rapid progress, and the correspondingly rapid accumulation of consequences, with their nature, extent and variety, are causing great concern in the world to-day. All this, however comprehensive it may appear, must be borne in mind by teachers when teaching science.

Social control over science is still an undeniable fact. Prof. J. D. Bernal, in his "Social Function o Science", has given a comprehensive analysis of thi social influence, but science has now acquired a momentum and strength of its own. It is not conten to accept the problems society suggests to it. I also states its problems to society. Science must b recognized as a very powerful social force which ha certain social requirements for which it demand satisfaction. This aspect of science must not b ignored in the schools of the future.

Although there are a utilitarian side and a cultura side to science, there is no distinct boundary betwee the two. Base desires are often associated with, an give an unpleasant sound to, the word 'utilitarian' This is probably due to the fact that many people ar not primarily interested in the investigation of socia life or in the formulation of what the scientifi attitude has to contribute towards it; but if 'utilitarian' means making man of use to himself and t his fellow men, the word is rescued from that unpleasant association. In this sense it covers knowledge c how to treat one's body, how to conduct one's ow business, how to help others, how to make use of the public services, and so forth.

Bearing in mind the conditions under which our children are going to work and live after leaving school, and still keeping to the utilitarian point of view, we must ask ourselves what knowledge of science we can reasonably and profitably give to them. Without attempting too much vocational training, we should try to make pupils receptive, ready to appreciate what is told them in the name of research, and to respond to advice. The cultural side refers to the effects of science on the minds of children and of the men and women they will become. This is emphasized in the Report on the Teaching of General Science prepared by the Science Masters' Association: "Of all the claims made for the inclusion of science in a school curriculum, the strongest undoubtedly is that which stresses the cultural value which the subject possesses". The cultural value of science is derived from its many lessons. We learn of the littleness of our powers and actions, and at the same time we are encouraged to increase them by observing, thinking and planning. The cultural side of science teaching brings us also into close relations with all our efforts to make the pupils see what is good and beautiful. It might well give them happy interests in their leisure time.

Here we are at one with the British Association Committee in that the humanities and science should work together. Whatever is done at the dictates of the humanities is based upon observation of the world, its natural processes and the behaviour of living things. While the humanities study the doings of men, natural science helps to explain their conduct: while the humanities teach us to work for the common good, science shows us how to make goodwill more effective.

Taking the views here expressed of science in education, the Norwood Committee's Report is far from encouraging. In fact, it is frankly disappointing. Its references to science are sometimes vague and frequently outmoded. It is difficult, for example, to understand the remark in the introduction to the Report that: "We have no sympathy, therefore, with a theory of education which pre-supposes that its aim can be dictated by the provisional findings of special Sciences, whether biological, psychological, or sociological, that the function of education is to fit pupils to determine their outlook and conduct according to the changing needs and changing standards of the day".

In Chapter viii of the Report we find support for our views so far as the lower forms of secondary schools are concerned. It is there suggested that science should take the form of a general approach to the main fields. This approach has now become known as general science, and the Committee proposes that the study of natural science here should be related wherever practicable to the everyday experiences of the pupils and should be drawn from the whole field of natural science and treated as a coherent whole, so that the questions of the division into separate science subjects such as physics, chemistry, biology, astronomy and geology does not arise. Furthermore, we are glad to see the Committee deprecating a tendency which is extant in many of our schools, namely, allowing the school environment to dictate too much what kind of science shall be taught, for, as the Committee emphasizes, this causes a syllabus to become over-specialized. For example, in rural schools it is natural that interests in agriculture and rural industries should take pride of place, but there is a tendency to take this too far, for many of the children in such schools have no interest in such industries, and thus they become the victims of a one-sided education for which they are not suited.

When discussing science in the main school, the Norwood Committee makes very few suggestions towards genuine reconstruction. It still discusses scarcely anything but the subjects of physics, chemistry and biology. It is true that it speaks in favour of general science; but this subject is still in the experimental stage, and the Committee makes no constructive suggestions for further experiment along these lines. General science is still, in most cases, a potpourri of physics, chemistry and biology. Pride of place is given in the Report to the problem of the pre-medical students. It is to be hoped that eventually no school will feel disposed to look upon any follow-up university course as dictating its policy.

While, therefore, the main forms of the secondary schools are still allowed to look upon science as being composed of scarcely anything but physics, chemistry and biology, the outlook for science as a true educational tool still remains grave. The Committee's suggestion, however, that science teaching should be remodelled on lines which will attempt less factual knowledge but a surer grasp of principles and methods is more encouraging.

In the Report, the history of science is only hesitantly mentioned: the social implications of science are almost completely ignored. In fact, almost everything suggested in Chapter viii of the Report has been suggested time and time again: for example, the Board of Education Pamphlet No. 89 says: "A knowledge of the facts and principles gained by scientific workers should result in a more rational mode of life; not only is such knowledge of benefit to the individual, but to the community as a whole". This statement goes further along the road towards reconstruction in science teaching than does the Norwood Committee.

Few of the children being taught to-day will become research scientists, but all of them will grow into citizens, who, as part of the State, ought to take an interest in public well-being and the health and happiness of their fellows, and all will carry with them to the end of their days a living body obeying certain laws.

Prof. Julian Huxley expressed somewhat similar views on the Report in the *Times Educational Supplement* of August 28. He points out that science will continue to be the chief agency in man's control of his own destiny, yet there is no recommendation in the Report that science could, let alone should, be taught in a social context. On the other hand, strong emphasis is placed on the social relevance of art. Lack of balance in its attitude towards science is, as pointed out by Prof. Huxley, betrayed by the Committee in its advice to teachers to give definite instruction about the 'limitations' of science and scientific method (sound and wise advice), yet without giving similar advice concerning art, history or religion. We agree with Prof. Huxley that the points raised by the Committee are so stressed as to become a virtual denial of the social relevance and of the social function of education. "They need reformulation by those who think in terms of facilitating social change instead of (perhaps unconsciously) resisting it."

Further support for the sociological and scientific approach is given by Prof. Olive Wheeler (*Times Educational Supplement*, October 2), who deplores complacency with traditional ideas and methods of education. "The use of the scientific method of investigation in the various fields of education, the patient discoveries of biologist, psychologist, and sociologist concerning the nature, development, and varieties of individuals and societies, as well as the experience of practical teachers, will be needed to provide detailed content to this ideal of education in any effective planning."

As Mr. J. B. Priestley pointed out in an address to the International Youth Centre on September 18, return to the old world of 1939 is neither possible nor desirable. In future, there must be a planned society. The old idea that if a man seeks self-interest the good of society will result might have been true in another age, but it is not true to-day. To-day and to-morrow must see co-operative endeavour. But we cannot plan a society which we do not understand, and understanding can only be assured by scientific research and scientific education.

We fully realize that the social sciences and the social implications of science are not easy to teach, especially to such young pupils. But in spite of this the social sciences should be developed in our schools because (*a*) they are very effective in facts and ideas ; (*b*) they can be made far more interesting to the average child, who does not intend becoming a professional scientific worker, in that they show a closer community with man and his environment ; (*c*) they rely less on routine, time-destroying laboratory experiments, but lead to demonstrations and experiments on the self and other activities such as visits to farms, factories, water-works, hospital laboratories, council chambers, etc., and to talks from such officials as politicians, foreign visitors, medical officers of health, nurses, and so forth.

In our schools science should be utilized in the study of such problems as individual and public health, of nutritional standards, housing, population movements, race and nation, family life, of the relations and responsibilities of one person to another, and of the social policy of the State. Thus can the question of personal conduct, moral values and character formation be effectively approached. Though a certain amount of fundamental principles such as is found in the present-day subjects will of necessity be taught, all this cannot be covered in the usual sections of physics, chemistry and biology. (As a correspondent in the *Times Educational Supplemen* of September 25 writes : "The Norwood Report cannot get away from the 'subject' mentality". The sooner our educationists tear themselves away from this subject bogy, the sooner will science come into its own as an educational discipline of the first order.

Prof. A. G. Tansley put the matter ably in his Herbert Spencer Memorial Lecture at the University of Oxford in 1942 : "Scientific culture, then, must take its place on equal terms beside literary and artistic culture. . . . Why, then, we naturally ask, is science regarded with dislike and distrust by too many cultivated people who are supposed to have a libera education, and by the great majority of the population as a rather mysterious, esoteric agency which produces all sorts of mechanical contrivances but in which they have no part or lot ? It is . . . *because scientific education has been kept in watertight compartments and almost exclusive stress has been laid on its material achievements to the neglect of its cultural values.*"

Science stands to gain little and to make scarcely any headway in our educational system until its value as a medium of real culture, apart from its vocational value, is recognized by all, and especially by educationists. For after all is said and done ignorance of the public and its lack of appreciation of intellectual disciplines is invariably due to lack of education, or at any rate knowledge.

THE UNIVERSITY IN MODERN LIFE

ONE of the factors responsible for the greater interest which is now being taken in educational reform is the realization of the extent to which technical efficiency depends on education. The point has been made repeatedly with regard to our export trade and is reiterated in a recent Chatham House paper, "Industrialisation and Trade". In this study, of the changing world pattern and the position of Britain, Mr. A. J. Brown points out that there is ample evidence of room for improvement on pre-war practices through the more effective training, recruitment and use of managers and technicians, both industrial and commercial, in respect of which Britain has lagged sadly behind some other countries, and he stresses the urgency of this matter.

Another factor focusing attention on education especially higher education, as the last man-power debate in Parliament has shown, is the dependence on efficient management of wise use of our reserves of man-power and woman-power. That is the only sure means by which, whether in the Fighting Services, in the Civil Service, or in production, we can ensure that the maximum use is made of the limited resources we possess. The opposition to the extension of the call-up of women, as that debate clearly showed, is not opposition to a higher age limit in principle, but arises from doubts as to whether any effective use will be made of the services of the women ffected—doubts, in fact, whether all the effort volved may not in the aggregate be merely robbing eter to pay Paul.

Fundamentally, as the examples of the misuse or buse of labour cited in the debate indicate, this is n indictment of management, and both in the Civil ervice and in industry there can be no doubt of e shortage of managers and administrators of firstte quality. That is part of the price we must pay r the neglect of scientific management during recent ecades, and it is idle to expect the position to be ectified overnight. The warning must be heeded one the less, and every effort made now to see that e are not again placed in a similar position. Morever, it is as important in regard to post-war reconruction as in relation to the immediate prosecution f the war effort. This point is well brought out by r. H. E. Dale in his Sidney Ball Lecture, "The ersonnel and Problems of the Higher Civil Service", hich has recently been published as Barnett House aper No. 26. However inadequate his suggestions r Civil Service reform may appear—and there are o doubt some who will regard his attitude on comulsory retirement and on a staff college as reactionary -he at least makes it abundantly plain that the uality of the Civil Service is intimately related to e vitality and adequacy of the whole educational stem of Great Britain. Reforms which eliminate diminish the numbing effects of the examination stem and supplement that system with other vital sts equally free from the dangers of favouritism or ass prejudice, which encourage the understanding f men and affairs, will react on the Civil Service no ss than elsewhere. Mr. Dale is on firm ground in aintaining that any staff college or refresher courses ould encourage contacts with men of other prossions and occupations outside the ranks of the ivil Service itself, and that they would be better eld at universities rather than concentrated at a ecial institution.

The contribution of the universities in this matter training for leadership, both those who are entering dustrial or professional life for the first time, and ose specially marked out for high administrative sponsibilities at a later stage in their career, or, ain, in the provision of refresher courses, cannot ell be assessed without some reference to the broad estion of the function of a university in a modern mmunity. That was indeed one subject discussed the conference arranged by the Association of ofessors and Lecturers of Allied Countries in Great itain last April. It has received some attention an interim report of a committee of the British ssociation on Post-War University Education and atured in a recent House of Lords debate on ientific research.

Recent events and the White Paper on Educational econstruction have brought the whole question to e forefront. The British Association Committee commended that entry to universities should as a le be deferred until after a year of approved national international service, whether civil or military. hat suggestion was endorsed by the Nuffield College Statement on Industry and Education", and has in part been taken up by the Norwood Committee on Curriculum and Examinations in Secondary Schools, which recommends that full consideration should be given to the educational and social advantages of the performance of public service for a period of six months falling between school and university or other courses of higher education.

Although, therefore, the Norwood Committee was only indirectly concerned with university education, it is clear that its proposals are designed to encourage the type of reform in higher education which Mr. Dale has in mind. That much follows from the specific pronouncements in the brief section of the Report referring to universities and colleges. The Committee, for example, does not believe that it is to the interest of the nation that entrance to the universities should be of a purely competitive nature, regard being paid solely to achievement in a written examination. That is Mr. Dale's contention and it is implicit in the conclusions of the Nuffield College statement also. Again, the Norwood Committee records a veiled warning against overstocking the country with university graduates of mediocre capacity and attainment, and also its conviction that residence in a college or hostel, at any rate for the major part of the course, is essential to the fullest university life. It regards the encouragement of more life in common, together with an extension of the tutorial system to which residence would contribute, as among the most urgent needs in the development of the newer universities. The university, it holds, will best be enabled to fulfil its function in the life of the nation if it brings together within its walls men and women drawn along many channels from all sections of the community and possessing endowments of intellect and character of a high order. Such reasons alone would enforce reconsideration of the whole position of the universities in the proposals for educational reconstruction, apart altogether from the influence which the universities exert on the school and scholarship examination system, which properly fell within the terms of reference of the Norwood Committee.

The position and function of the university is ably discussed by Mr. Bruce Truscot in his lively volume, "Redbrick University"*, which could scarcely have appeared at a more opportune moment. Possibly, indeed, it is too lively, for while he does not fail to focus attention on the fundamental questions as to the real place of the university in a modern community, he writes with such vivacity on so many secondary questions that discussion of the primary questions is at times interrupted, if not confused, by the secondary controversies his mordant wit provokes.

The criticisms and conclusions which emerge from Mr. Truscot's comprehensive survey fall into two categories: those relating to questions of broad policy or objectives, and those relating to the technique by which policy is to be implemented and objectives realized. However far we may accept Mr. Truscot's own conclusions and suggestions in either field, his first main conclusion is common to both: "The first reform, which must precede all the rest, is the allocation to the modern universities of a Treasury grant many times larger than at present". Even if some of Mr. Truscot's suggestions achieve all that he anticipates in securing that the present resources are expended more effectively, his book makes it abundantly plain that the modern universities need a far larger annual free income to do the work they wish to do, and which they are capable of doing, as well as liberal grants for capital expenditure. The weakest spot in the White Paper on Educational Reconstruction is, in fact, the meagreness of the proposed grant for technical and adult education.

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* Redbrick University. By Bruce Truscot. Pp. 191. (London: Faber and Faber, Ltd., 1943.) 10*s*. 6*d*. net.

Mr. Butler obviously wishes to develop much closer collaboration between industry and commerce and the education service, and to associate the technical colleges and art schools more fully with the industrial and commercial life of Great Britain. Even in the fourth year of his plan, however, the additional expenditure contemplated on technical and adult education together from public funds is only £100,000 more than that of the unreformed post-war years; and this sum is quite inadequate for any major advance towards a system in which the technical education of potential skilled workers, industrial leaders, and commercial executives is no longer left largely to the initiative of the young employees themselves. Certainly it precludes any attempt to develop the large technical colleges under State control into higher technological institutes of the type encountered in European countries and the United States, engaged primarily with higher technological teaching and with technical research and development.

This point was made in the House of Lords debate on scientific research, notably by Lord Pentland, who urged the desirability of such institutions as the Massachusetts Institute of Technology, and the importance from the point of view of scientific research of adequate endowment of both universities and technical colleges was well put by Lord McGowan. Educational policy, no less than the organization of scientific and industrial research, demands that we should have clear ideas of the place of the universities, the technical colleges, and the special research institutions in our educational system and research structure, and of the functions they are to serve. That is the first essential before we can consider profitably their inter-relations, and apportion wisely the available national resources.

On this question Mr. Truscot's ideas are clear and challenging. To their exposition, indeed, he devotes three if not four of his seven chapters. The core of his argument is indeed in the second chapter, which is a spirited defence of the idea of a university as a corporation or society devoting itself to a search after knowledge for the sake of its intrinsic value. He unhesitatingly maintains that research rather than teaching is the essential function, and challenges Sir Charles Grant Robertson's denial that a research institute cannot be a university in the purest sense of the word. The two aims and the two functions should indeed be there, but the primary aim must be the search for knowledge, the creation and cultivation of the spirit of discovery. The discipline of research is as much more beneficent than the discipline of conscientious teaching and application to knowledge as research itself is a nobler activity than teaching and learning.

On this question of research Mr. Truscot writes wisely and convincingly, and his criticism of much of what passes for research is no less trenchant because in contrast to Flexner, his criticism is constructive rather than destructive. The case for academic research could scarcely be better presented than in the chapter he devotes to this question, and his constructive ideals are set forth persuasively and suggestively. That chapter should do much to restore the dignity of a word often debased in current usage and to demonstrate the place which research should occupy as the inspiration and crown of a libera education. Nor is it without relevance to the conditions which are conducive to research of the highest calibre, whether conducted within the walls of a university, a Government department, or the laboratories of an industrial firm.

Although the first place is given to research, the discussion of teaching in this volume is no les stimulating and penetrating. Mr. Truscot effectively disposes of some of the cruder views advanced at some of the National Union of Students conferences If 'freshmen' came to the universities with a burning desire for general knowledge, he remarks, they would find ample means of feeding it, even as the universities are at present. Again, he points out that it i only when one begins to know a subject deeply tha the critical faculty has any real scope. Only by seeing that students' knowledge is sound and deep, and a the same time seeking to inspire them with the spirit of adventure and research, can we ever develop a critical faculty in them at all. That is done, primarily through the honours course, and to a lesser exten through a general course of not more than three mai subjects, of which one at least has close relations with one or both of the others.

Mr. Truscot makes a sound defence of the lectur system and of the honours system within limits, an suggests that premature specialization should b looked for in some of the subjects in the Highe Certificate examinations rather than at the university. His fundamental argument is that the whole art o educating the undergraduate, in the deeper sense must be based upon instilling into him the true ide of the nature of a university. This is one of the reasons for his insistence upon the research function for it cannot but facilitate the break with traditio and the text-book. The student who has throw off such shackles, developed a limited trust in his own judgment and a desire for the time to come when he can trust it more, has, as Mr. Trusco remarks, learned the inner meaning of university education.

The emphasis on the necessity of imparting the ide that the undergraduate's teachers at the university—his fellow-members—are not so much teachers as collaborators, learners like himself but in a con derably higher class, and his remarks on the place the university library in stimulating thought, are no ss sound and suggestive. But although he represses e excess of vocational aspirations, Mr. Truscot cognizes that vocational training has its place. In e ideal of service all three functions—research, aching and vocational training—have their natural eeting place, and this keynote of service inspires e concluding chapter of the book, on the external ntacts of the university. Here, too, are vision d insight on the contribution which the modern iversity might make to the service of the community in the city and district which are its home, d from which the majority of its students may be awn. On the measure in which are fulfilled those ssibilities of adult education, such as the interetation of the issues involved in current political d international affairs, and appreciation of the nctions of the Press, the future of democratic titutions may well depend.

Mr. Truscot's book is full of practical common nse. He deals with practice as well as theory, and his vision of the university and its contacts he can rn aside, for example, to enunciate sound rules for ccessful lecturing. But no less than Newman and exner, he has a vision of the greatness of the iversity ideal, and senses the dangers from within its high traditions of independent and creative ought; the note of service which he strikes insistly is no less persuasive because his ideals are linked h plain counsel on the technique by which they to be achieved. Finance, indeed, is a first conion, and above all more generous endowment from State if the universities are to play a worthy part the post-war world. But they also need insight d vision for wise planning, common sense, deternation and energy. Mr. Truscot's little book erves to be widely known and read, for it should ke a modest but effective contribution in stimung the reforms from within, the clearing away of bish, and pruning of dead wood, which are as ential as adequate endowments if the universities to follow in the coming age their high traditions service and of leadership, and to seize the wider portunities now before them.

"STUDENT" AND THE NEW BIOLOGICAL STATISTICS

udent's" Collected Papers
ted by E. S. Pearson and John Wishart. Pp.
+ 224. (London: Biometrika Office, University
lege, 1943.) 15*s*. net.

would be idle to suppose that biologists are making ull use of the powerful tool given to them by modern istics, or even that they are likely to make full of it before statistical teaching has improved. ertheless it cannot be denied that notable adces towards this desirable end have been, and being, made. The biologist is at least coming to ize something of the value of statistics, and to rd the statistician as a welcome ally, who will st in making the most of limited experimental resources, rather than as an unhelpful critic, likely to reject the results of laborious experiments as constituting too small a sample to permit the drawing of statistically reliable conclusions.

This changing attitude reflects, indeed is conditioned by, a corresponding change in statistics itself. Until thirty-five years ago the statistician had no means of treating a small body of data on its merits. It was, of course, to him a sample from a larger population, and if the quantities defining that population, parameters as they are called, were known, the properties of the sample could be deduced. But there was no way of deducing these properties from the sample itself, because a sample yields only estimates of the basic parameters. Estimates are subject to sampling error, and the smaller the sample the larger this error is likely to be. Thus analysis was of necessity confined to samples sufficiently large for estimation to be regarded as yielding the 'exact' values of the parameters within very close limits. Beyond this the statistician dared not go, for his methods ceased to be applicable. Most experimental work in biology was thereby excluded.

Now, however, the distributions of quantities based solely on the estimates, and independent of the exact values of the parameters estimated, have been determined. Assumptions concerning the parameters, as distinct from their estimates, need no longer be made, and rigorous analysis of small bodies of data has become possible. The rich development of this field must always remain associated in a special way with the work of Fisher, but "Student" will be remembered, too, as the man who, without being primarily a mathematician, first saw in 1908 the possibility of this new approach, and who calculated the first of the distributions which make possible the confident analysis of small samples.

W. S. Gosset, to give "Student" his real name, published twenty papers and six shorter communications between 1907, when he was thirty-one, and his death in 1937. A twenty-first paper appeared posthumously in 1938. Though fourteen of these papers were published in *Biometrika*, the remainder were scattered throughout eight other journals. We are thus indebted to Prof. E. S. Pearson and Dr. J. Wishart for now making possible a balanced appreciation of the work of this remarkable man by collecting these papers into one volume.

"Student's" papers fall into three groups. Up to 1919 he was mainly concerned with what may be described as distributional problems, and this phase includes the paper (1908), for which he will be mainly remembered, containing his derivation of the forerunner of the modern t distribution. (His tables of t were finally published in 1925.) This had been preceded by his consideration of the distribution of hæmacytometer counts, which were shown to give a Poisson series, and was followed by a somewhat less successful consideration of the distribution of the correlation coefficient. The remaining papers of this period are of less general interest, though in an appendix to Mercer and Hall's article on field trials (1911) "Student" foreshadows his later work on agronomical trial design. This topic forms, in fact, the subject-matter of the majority of the papers of the second group, from 1923 until his death. Interposed between the groups is a discussion (1921) of the efficiency of Spearman's correlation methods, and there is later (1927) an account of the errors of routine analysis. The third and smallest group consists of two papers on the genetical theory of selection, in which he points out the immense evolutionary importance of the store of heritable variability which a group of organisms will generally possess. In these papers, too, the estimation of the number of genes affecting oil content in Winter's maize is attempted.

The reader of this collection cannot fail to be impressed by the way in which most of the papers, including, we venture to say, all of first importance, are concerned with problems encountered by the author while engaged as a scientific worker in the employment of Messrs. Guinness. His consideration of estimating yeast density by hæmacytometer counts, his long interest in field trials of barley varieties, his discussion of the errors of routine analysis, all reflect different aspects of this work; and, above all, his derivation of the ratio he termed *z* (not to be confused with Fisher's *z*), later to be transformed into *t*, reflects the necessity for drawing, from small samples, conclusions of a reliability sufficient to serve as the basis for executive action. Herein we can find the clue to "Student's" success; he was an experimental scientist who knew what he wanted statistics for, and when existing methods failed him, undertook for himself the development of new ones which would work. His mathematics was not always of the most elegant, indeed it was on occasion neither fully rigorous nor wholly successful; but he always tackled the problems which faced him in a downright fashion, using experiment and arithmetic to check his algebra, by methods which must appeal to all those of us who, like him, are not professed mathematicians yet find statistical analysis essential in our experimental work.

"Student" ushered in the new era of collaboration between statisticians and experimenters. But his work was not only hampered by the statistical conventions of his early days; it seems also not to have been fully appreciated by some of his statistical associates, for so late as 1931 we find him defending his small sample test against criticism by Karl Pearson. Nor did "Student" realize the full consequences of his great discovery. The moulding of statistics into the powerful weapon of to-day awaited Fisher, and the effects of Fisher's influence is to be seen in many of "Student's" papers after 1915. In the 1930's, something of a controversy developed between the two, on the necessity for randomization in field trials, and here "Student" took the curious stand that, while we must "superpose randomness on the biassed fertility of the soil", this could as usefully be done by certain systematic arrangements as by actual randomization of the plots. Indeed he claimed in his last paper that not only could sampling error be minimized in this way, but that even if it led to a slightly biased estimate of error, the bias was in a helpful direction.

It would, however, be surprising if "Student's" papers did not in places seem open to criticism by the reader of 1943. Nor can such criticism detract from the value of a volume of this kind. These papers are primarily "Student's" record of his results and findings; but they also reveal to us the needs which prompted his work and the way in which he set about it. Few experimenters can fail to derive a new confidence for the attack on their own problems from seeing how his clear recognition of the statistical needs of experiment, and his practical approach to their satisfaction, enabled "Student" to mark the way to the new statistics, the benefits of which we can now enjoy.

K. MATHER.

OPTICAL METHODS IN CHEMISTR

Optical Methods of Chemical Analysis

By Dr. Thomas R. P. Gibb, Jr. (Internation Chemical Series.) Pp. xiv+391. (New York McGraw-Hill Book Co., Inc.; London: McGra Hill Publishing Co., Ltd., 1942.) 35*s*.

LIKE so many other activities, analytical chen istry is becoming mechanized. A training the standard procedures of gravimetric and vol metric analysis is, of course, still essential for tl chemist, but it needs to be supplemented by e perience in the use of a large variety of instrument many of which are optical. Dr. T. R. P. Gibb is a instructor in analytical chemistry at the Massach setts Institute of Technology; he has managed (quote his preface) "to present a compact, abridge survey of optical methods of analysis in a sty suited both to the practical analyst and to tl advanced student of analytical chemistry". H teaching experience has obviously been gained i splendidly equipped laboratories, and the problen given at the end of each chapter are a clear indicati that the task of teaching the newer analytical metho is being tackled on a scale and with a gusto hither impossible in Great Britain.

It is impossible to avoid comparing this book wi some of its predecessors. Löwe's "Optische Messung des Chemikers und des Mediziners" (Steinkop Dresden and Leipzig, 1933) is a very useful technic progress monograph for research workers, while Fri Weigert's classical "Optische Methoden der Chemi (Leipzig, 1927) remains the best comprehensive wo for the serious student of the subject, although it to some extent out of date as regards the design instruments. It seems unlikely from the text th Dr. Gibb has seen either of these books, but in spi of that handicap he has written a very usef laboratory handbook.

The chapter on spectrochemical analysis provid a skilfully chosen minimum of information f effective practical work. His treatment of spectr photometry displays more interest in instrumen than applications and is, perhaps, a little unbalanc on that account. Any chemist inexperienced in tl use of microscopes, colorimeters, nephelometers fluorophotometers, will find the construction of su instruments and details of their manipulation giv very lucidly. Dr. Gibb has an excellent account elementary crystallography, and his description the identification of crystals with the polarizi microscope will be of special interest to unive sity teachers who are concerned with the revisi of practical chemistry curricula. The refract meter and the polariscope are quite adequate treated.

The book as a whole is clearly written and effective illustrated. The selection of references for furth reading has been done well, but theoretical conside tions and the general problems of interpretation ha been dealt with too cursorily. The chemist q skilled technician will find the volume admirab but teachers in Great Britain may doubt wheth the scales have not been tipped too far on the si of sheer technique. In terms of the programme ou lined in this book, universities and colleges outsi the United States are seriously under-equipped the teaching of modern analytical chemistry, a the scales are weighted in the opposite directio

R. A. MORTON.

THE SIGNIFICANCE AND DEVELOPMENT OF HAMILTON'S QUATERNIONS

By Prof. H. T. H. PIAGGIO

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A HUNDRED years ago, on November 13, 1843, Sir William Rowan Hamilton read to the Royal Irish Academy his first paper on quaternions. The centenary is being celebrated by the Academy, and the Government of Eire is issuing a special postage stamp commemorating Hamilton's work. Hamilton's treatises, in the opinion of Prof. P. G. Tait, an "only be compared with the 'Principia' of Newton and the 'Mécanique Céleste' of La Place as a triumph of analytical and geometrical power". On the other hand, Lord Kelvin declared that quaternions, "though beautifully ingenious, have been an unmixed vil to those who have touched them in any way, including Clerk Maxwell". It is difficult in the present relativist age to be as certain of anything as the Victorians were of everything, and we shall examine the conflicting points of view, indicating both majority and minority opinions. But before discussing these controversial matters, it is advisable to recall the facts concerning Hamilton and his discovery.

Hamilton was born in Dublin on August 3, 1805. He showed signs of great ability at a very early age. He could read well at the age of three. At five he translated Latin, Greek and Hebrew, adding Italian and French at eight. At ten he began Arabic and Sanskrit. At twelve he had studied Syriac, and had also engaged in contests with Zerah Colburn, the American 'calculating boy'. Hamilton was defeated, but he was able to analyse Colburn's methods, which Colburn himself did not fully understand. Possibly this was partially responsible for turning Hamilton's attention to mathematics, though for some time he devoted at least as much of his time to languages, chiefly Latin and Greek, but also Sanskrit, Persian and other Oriental tongues. He entered Trinity College, Dublin, in 1823, and was first in all subjects at all examinations. His career as a student ended in an unprecedented way; he was, while still an undergraduate, elected in 1827 as professor of astronomy. The observatory was badly equipped, and Hamilton lacked the immunity to cold necessary o a successful practical astronomer. Perhaps this was really fortunate, for otherwise he might have wasted, in routine observing, time and energy more profitably devoted to research in mathematical physics. In 1828 he published the first instalment of his researches on optics, which led on to his fundamental work in dynamics. To explain this would take a whole article in itself. All that is relevant here is that, although the real magnitude of the achievement could not be fully appreciated until the creation of modern quantum dynamics in 1925–26, it was realized sufficiently to give Hamilton a great reputation. One particular piece of work, the prediction of conical refraction in crystals, was easily intelligible to both mathematicians and physicists, and this spread Hamilton's fame far and wide. He was knighted in 1835.

The discovery of quaternions had little or nothing in common with Hamilton's researches on mathematical physics, but arose out of difficulties in elementary algebra. The occurrence of i, which denotes the square root of minus one, in roots of quadratic equations, was for long regarded as an algebraic fiction, from which, surprisingly enough, true results could be obtained. Then several contemporary writers, Wessel (1797), Argand (1806) and Gauss (1831), found an explanation. If we consider i to be an operator which turns a line through a right angle, the 'complex number' $x + iy$ represents a point P obtained by going a distance x along a line Ox, say to N, and then a further distance y along a direction NP perpendicular to ON. Alternatively, we may consider $x + iy$ to represent, not the point P, but the displacement of O to P, or again the line OP. It then appears that the addition of two complex numbers exactly corresponds to the compounding of two forces by the parallelogram of forces. Instead of forces we may consider velocities or accelerations. All these quantities, which have both magnitude and direction, may be called *vectors*, and so the addition of complex numbers corresponds to the addition of vectors, and similarly for subtraction. When we come to multiplication of one complex number by another, we find that the process corresponds to the combined turning and stretching of a vector, producing another vector in the same plane, and similarly for division.

Hamilton pondered for many years over this geometrical theory of complex numbers, and gave an alternative treatment, purely algebraical, in which $x + iy$ was considered as a couple of real numbers x and y, obeying certain laws of operations. The full importance of this did not appear until much later. The immediate question that arose was why algebra should correspond to operations confined to one plane. It was easy to think of the addition of vectors in space, but what was the corresponding complex number which Hamilton considered as a *triple* of three real numbers x, y and z? It seemed as if we needed something like $x + iy + jz$, where j had properties somewhat similar to those of i. More symmetrically, Hamilton considered $ix + jy + kz$. But the central difficulty was how to multiply such numbers. This problem had already defeated mathematicians of great ability, though it is now known that Gauss, in a brief abstract which he wrote probably about 1819, but never published, seems to have anticipated some of Hamilton's work. Hamilton struggled with the difficulty for fifteen years, sustained in the later stages by the sympathy of his family. "Well, Papa, can you *multiply* triplets?" was his breakfast greeting from his two little sons, aged eight and nine, and he had to shake his head sadly and reply that he could only add and subtract them. But on October 16, 1843, when he was walking with his wife along the Royal Canal, "an electric circuit seemed to close and a spark flashed forth", and he suddenly saw that the solution of his difficulties could be found if he postulated the rules $i^2 = j^2 = k^2 = ijk = -1$.

In his enthusiasm Hamilton cut these symbols on a stone of Brougham Bridge. The incident has been the subject of a drawing by the Irish artist, Sean Keating. The real novelty of these postulates lies in the implication that $ij = -ji$, a *non-commutative* law of multiplication. This would be obviously untrue if i and j were ordinary numbers. But consider a sphere of centre O, with three mutually perpendicular radii Ox, Oy, Oz, and a rod, of length equal to the radius, freely pivoted at O. Guided by the meaning given to i in two dimensions, let us now interpret i as a rotation through a right angle of the rod about the line Ox, bringing its free end from y to z. Similarly

j brings it from z to x, and k from x to y. We take $-i$ to reverse the operator i, and so to bring the free end from z to y. Now we can bring it from x to y by bringing it from z to y, after having previously brought it from x to z. This gives $k = (-i)(-j) = ij$. Similarly we can bring it from y to x by bringing it from z to x after previously bringing it from y to z, so $-k = ji$. On this interpretation the non-commutative law $ij = -ji$ becomes obvious.

Having got over the difficulty of multiplication, Hamilton next considered division. He found that the quotient of two vectors, like their product, was not itself a vector, but the sum of a vector and a *scalar* (that is, a quantity having magnitude but not direction), say, $w + ix + jy + kz$. As this was the sum of four parts, he called it a *quaternion*. Although his first approach had been algebraical, he now founded his system on the quaternion defined as the geometrical operation (a combined turning and stretching) that converted one vector into another. All mathematical operations such as addition, subtraction, multiplication and division of quaternions resulted in other quaternions, so the way was now clear to build up a complete system, and to explore its numerous applications to geometry, physics and astronomy. To this task Hamilton devoted the remaining twenty-two years of his life, asserting that "this discovery appears to me to be as important for the middle of the nineteenth century as the discovery of fluxions was for the close of the seventeenth".

Many shared this view, and Hamilton was lionized by Dublin society. In England, quaternions were welcomed and used so early as 1845 by Prof. A. Cayley, the greatest of British geometers. Great enthusiasm was aroused in the United States. In Edinburgh, Tait became the fervent apostle of the new mathematical gospel, and investigated the physical applications of the symbolic operator ∇, which, applied to a scalar, gives the direction in which that scalar increases most and the magnitude of its rate of increase per unit distance. Tait also produced "An Elementary Treatise on Quaternions" (first edit., 1867, second edit., 1873, third edit., 1890), which was very much easier to understand than either Hamilton's "Lectures on Quaternions" (1853) or his posthumous "Elements of Quaternions" (1866). Hamilton's books were both very long (about 800 pages each) and suffered from over-elaboration. At first it seemed as though Tait's force of enthusiasm would be irresistible, but he met an immovable wall in Sir William Thomson (Lord Kelvin), the co-author of the well-known "Treatise on Natural Philosophy". Kelvin wrote in 1901, of Tait: "We have had a thirty-eight year war over quaternions. . . . Times without number I offered to let quaternions into Thomson and Tait if he could only show that in any case our work would be helped by their use. You will see that from beginning to end they were never introduced". The attitude of Clerk Maxwell was less rigid. He considered that "the introduction of the ideas, as distinguished from the operations and methods of Quaternions, will be of great use, . . . especially in electrodynamics. . . ." Accordingly he suggested to Tait the use of the words *curl* and *convergence* (now replaced by its negative, *divergence*). However, in Maxwell's own treatise on "Electricity and Magnetism" quaternions appeared in only a few places. The general attitude of mathematicians and physicists was summed up in Maxwell's phrase: "The unbelievers are rampant".

But even more painful than the stubbornness of unbelievers was the lapse into heresy of some wh had at first accepted the true faith. Cayley's earl enthusiasm had cooled into the comparison quaternions with a pocket map, which containe everything but had to be unfolded into another for before it could be understood. The physicists remarked that quaternions themselves were not use so much as their scalar and vector parts. Why no said the American mathematical physicist, J. W Gibbs, discard the useless quaternion, and set up vector calculus, starting with simple geometric definitions of the vector and scalar products of tw vectors, and altering Hamilton's sign in the scal product so as to get rid of his ridiculous result tha the square of a vector was negative ? The quaternio ists pointed out that quaternions could not be avoid if we were to consider the quotient of two vector The vectorists replied that they had no need to co sider quotients, which were not required in physic All Tait's arguments for the utility of quaternions physics were seized and used against him, for the became even stronger when applied to vector analysi The controversy between the two sides raged wit almost theological bitterness[1]. Even more confusio was created when the vector analysts themselv split up into sects, differing only on minor points notation. A saner attitude was shown by C. J. Jol one of Hamilton's successors as professor of astronom at Dublin, and editor of the annotated second editio of Hamilton's "Elements of Quaternions" (1899 an 1901). Fully conscious of the logical completene of that great work, he nevertheless realized that mathematician whose time is limited may be frigh ened by the magnitude of Hamilton's bulky tome Joly, therefore, in his "Manual of Quaternions (1905), reluctantly abandoned Hamilton's method and started with Gibbs's definitions, except that th sign of the scalar product was different. Joly the defined a quaternion as the sum of a scalar and vector, and proved its fundamental laws. This metho appears to combine many of the advantages of bot schools.

Many mathematicians consider that the true valu of quaternions lies in their extension of the idea number. Hamilton's theory of couples was the fir step in the creation of the abstract algebras whic attract so much attention to-day. The non-commuta tive law of multiplication was the first hint, quick developed by Boole, that there is not one algebr but many, with a wide choice of fundamental post lates. From this point of view Tait's insistence the close connexion between quaternions and physi was, in the end, very unfortunate. For physicist quaternions have been displaced by vector analysi and later, with the advent of relativity, by the tens calculus. For the few surviving quaternionists it adding insult to injury that their supplanters ha stolen Hamilton's term *tensor* and used it in an e tirely different sense ! The tensor calculus al appeals to mathematicians, as it is applicable to a number of dimensions, whereas quaternions a essentially three-dimensional. Another n-dimensio extension of the idea of number, Grassman *Ausdehnungslehre* (calculus of extension) appeared early as 1844. Its merits have been obscured by t defects of its author's presentation, and, moreov it is so very general that there is great difficulty applying it to particular problems.

To sum up, in the opinion of the majority, t spirit of Hamilton's great discovery will survive, bo in pure mathematics and in physics, although t form in which he presented it has become merely of historical interest. But there is also a minority opinion. Prof. E. T. Whittaker[2] points out that Pauli's spin matrices of 1927 are simply Hamilton's *i*, *j*, *k*, and says[3], "I am inclined to conjecture that if the present range of problems were not extended, physicists would continue to prefer vector-analysis; but that the development of relativity and quantum mechanics will sooner or later require quaternion methods for the more difficult problems (as in Professor Conway's paper, referred to in my original article); and that when the physicists have thus been forced to learn quaternions, they will use them for all purposes, and vector-analysis will be forgotten".

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[1] NATURE, 1891–93. *Mathematical Gazette*, **25**, 106 and 298 (1941).

[2] *Mathematical Gazette*, **24**, 158 (1940).

[3] *Mathematical Gazette*, **25**, 300 (1941).

DEVELOPMENTS IN MICRO-CHEMICAL ANALYSIS

By E. J. VAUGHAN

A SYMPOSIUM on micro-chemical analysis arranged by the Micro-Chemical Club, the South Yorkshire Section of the Royal Institute of Chemistry and the Sheffield Metallurgical Association was held at Sheffield on October 9, and was preceded by a demonstration of micro-chemical methods and an exhibition of micro-chemical apparatus. The exhibition was very complete in character and included the latest design of micro-chemical balance, capable of weighing one milligram of substance accurately to 1/500 mgm., some physical instruments now used as the tools of the micro-chemist—notably the polarograph and photo-electric absorptiometer—and a variety of graduated flasks, pipettes, burettes and mixing vessels. Of the micro-glassware exhibits one of the most interesting was the Wigglesworth-type burette which was used in the determination of the sodium chloride content of the body fluid of a single gnat. This burette is usually home-made by the micro-chemist, being obtained by drawing out a piece of glass tube to an extremely fine bore, waxing the interior and exterior surfaces and mounting in a suitable glass tube. The waxing overcomes surface tension effects, a drop size something less than that of the head of the average pin is obtained, and each drop breaks cleanly away from the burette end.

The symposium included a number of papers covering a wide range of subjects, and produced some accounts of noteworthy advances made in the application of micro-chemical methods to the analysis of inorganic materials. The study of micro-organic and micro-biological methods has had considerable prominence in the scientific world, and from the evidence submitted it would now appear that the inorganic micro-chemist is advancing as rapidly as his colleagues in the other spheres.

Exigencies of the War have made many demands of the chemist, and not the least of these is the necessity of establishing the composition of metallic compounds when only limited samples are available. A detailed study of this problem has resulted in the formation of micro-chemical methods for the determination of alloying elements in steels and aluminium alloys. It is possible to determine manganese, titanium, copper, vanadium, molybdenum, phosphorus, nickel, chromium and silicon in steels on amounts of sample ranging from 10 mgm. in the case of the first three elements mentioned down to 2 mgm. in the case of the last two, and iron, manganese, nickel and copper in aluminium alloys, the weights of sample required being 10 mgm., 10 mgm., 2 mgm. and 1 mgm. respectively.

The methods are unusual in that they employ a chemical opening out and a physical finish. In all cases, the chemical procedure followed is to take the alloy into a suitable acid solution and then, by application of chemical reagents, form, with the element which it is desired to determine, a complex which gives rise to a coloured solution. The Spekker photo-electric absorptiometer is then employed to determine the light absorption of the solution, the chemical technique having been so arranged that the measured absorption is directly proportional to the concentration of the element being determined. The measured absorption may be obtained as the result of a single reading or the difference between two readings. An example of the former occurs in the silicon method, in which a silico-molybdate complex is formed and reduced by the addition of stannous chloride to molybdenum blue, the final condition of the solution being such that the other elements present do not give rise to a measurable absorption. The determination of manganese provides an example of the latter, for the oxidation of manganese to permanganate by potassium periodate also gives rise to the partial oxidation to dichromate of chromium. The total absorption is first measured, a drop of sodium nitrite to decolorize the permanganate then added, and the absorption due to chromium as dichromate measured.

The most recent advance in this field of work has established a composite method for the determination of manganese, molybdenum, chromium and nickel on a single 4 mgm. sample. This result has been achieved by the use of monochromatic light obtained through the use of a mercury lamp as light source, with suitable filters in the absorptiometer and the provision of specially manufactured micro-cells which may contain as small an amount of solution as 0·5 ml. but yet permit the passage of a narrow beam of light through a long column.

The actual weights of the elements under consideration present in the solution measured are of interest. Assuming each element to be present to the amount of 0·1 per cent of the sample, the weights in the absorption cell are:

Manganese	4×10^{-6} gm.
Molybdenum ..	$1{\cdot}6 \times 10^{-6}$ gm.
Nickel	4×10^{-7} gm.
Chromium	$3{\cdot}2 \times 10^{-7}$ gm.

Accuracy of the determination of such small amounts is claimed, and in each case a ten-division drum movement reading of the absorptiometer is recorded.

An example of a mainly chemical method of attack was provided by an account of a micro-method of gas analysis. The gas bubbles occurring in glass have been studied, means for their extraction developed and a technique for their analysis formulated. The whole process has been so well developed that bubbles of gas of the order of 4×10^{-3} c.ml. can be analysed for sulphuretted hydrogen, carbon dioxide, carbon monoxide, sulphur dioxide, oxygen and hydrogen. In order to extract a bubble of gas, the glass containing the bubble is ground down until it is 1/1000 in. thick, and the glass is then broken under glycerine. The bubble of gas floats to the surface of the glycerine, where it is retained by a microscope slide and its diameter measured by means of a microscope. The bubble is then removed by using a bent capillary pipette with an inner diameter not much smaller than that of the bubble, and transferred to a solution of cadmium acetate. Five minutes contact with this solution removes the sulphuretted hydrogen and the bubble is then transferred by means of the special pipette first to a glycerine-washing solution and then to the original glycerine solution for diameter measurement. The process can be repeated using 10 per cent caustic soda in glycerine for the removal of carbon dioxide, sodium hydrosulphite for the removal of oxygen, ammoniacal cuprous chloride for the removal of carbon monoxide and colloidal palladium solution containing sodium picrate for the removal of hydrogen.

A spot technique has also been devised whereby a very rapid qualitative test for the presence of a single gas can be made. For this purpose, specially constructed instruments for piercing glass are employed, to the contact ends of which the chemical reagents are applied, a microscope being used where necessary to observe any reaction. As an example of this spot technique for the detection of sulphur dioxide, a gramophone needle as the piercer holds at its point an acid solution of fuchsine decolorized with formaldehyde, and after piercing, the formation of a reddish-purple colour indicates the presence of sulphur dioxide in the gas. Although great accuracy is not claimed for this method owing to the fact that the gas bubbles are not always spherical and some of the constituent gases show partial solubility in glycerine, very valuable results have been obtained. It is proposed to compensate for solubility errors by carrying out the same process on samples of known composition.

Of the latest advances in micro-chemical analysis as applied to organic chemistry, the use of mercuric oxycyanide was cited. This micro-chemical reagent has been employed with advantage in the determination of sulphur, by making use of its reaction with barium chloride to form barium hydroxide. The normal sulphur method is followed so far as the precipitation of barium sulphate, a known amount of an accurately standardized solution of barium chloride being added, however, and then hydrochloric acid is removed by evaporation, and the barium hydroxide formed from the excess barium chloride by the addition of mercuric oxycyanide is determined by titration with standard sulphuric acid. The method has distinct advantages in that it permits a smaller sample weight than the gravimetric method, employs the accurate alkali-acid titration finish and overcomes errors due to incomplete precipitation of barium sulphate or co-precipitation of barium chloride. The application of this reagent to bring about an acid-alkali titration finish has been extended to the determination of ionic iodine and the methoxy radicle.

The polarograph has been employed for a number of years for micro-chemical analysis, but a recent innovation is the use of this instrument for amperometric titration. An outstanding example of an amperometric titration is the determination of copper and zinc using quinaldinic acid as the titrating medium. Using the polarograph to give a constant applied potential of $-0{\cdot}9$ volt to the solution of copper and zinc, the changes in current flowing are recorded against successive increments of quinaldinic acid. From the resulting graph, concentrations of copper and zinc are determined.

During the meeting, attention was directed to th lack of facilities in Great Britain for teaching microchemistry. The view was expressed that it can b taught to undergraduates successfully and should b included in the normal chemical syllabus. Detail of a six weeks course, which had been successfull introduced in a university degree course, were given.

In discussion, regret was expressed that facilitie are lacking for the pooling of micro-chemical knowledge—the symposium being specially arranged an being the first of its kind for four years. The meetin concluded by passing a resolution expressing it desire that everything possible should be done t further activities of micro-chemists, and appointe an *ad hoc* committee to consider the best means b which this aim could be achieved.

PROBABLE FUNCTION OF HISTONE AS A REGULATOR OF MITOSIS

By DR. E. STEDMAN, F.R.S., AND MRS. ELLEN STEDMAN

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UNTIL the recent discovery of chromosomin[1], th histones (and protamines) were regarded as th typical proteins of cell nuclei, a view which w fairly well founded as regards fish spermatozoa[2], bu which lacked any certain experimental basis wit respect to other and more typical forms of nucle Kossel[3] and Ackermann[4] had, it is true, demonstrate the presence of a histone in the nuclei of avian er throcytes by extracting it directly from the isolate nuclei, but no detailed study was made of its chemic composition and properties. Apart from this i stance, no histone has, so far as we are aware, bee extracted directly from any nuclei other than tho of spermatozoa. Nevertheless, histones have bee isolated from various tissues, in particular from t thymus gland; more recently, Mirsky and Polliste have prepared nucleoproteins, in which the protei component is believed to be either a histone or prot mine, from a variety of animal tissues. There is th presumptive evidence that, while the traditional vie that the protein components of nuclei are chiefly entirely histones is, as we have shown[1], incorrec histones do nevertheless occur widely among t constituents of nuclei. Nothing, however, is know concerning the function of histone in the nucleu Of the two other main constituents, chromosomi the principal component of the chromosomes, mus according to our experiments, represent the chemic basis of inheritance, while there seems little dou that nucleic acid is concerned mainly with spind formation during mitosis and, in combination wit chromosomin, with protein synthesis during t resting stage, the nucleoprotein then formed by the union being analogous to the self-propagating nucle proteins of which the viruses are now believed to b composed.

This picture of the cell nucleus at first sight leav no place for histone. Partly with the object gaining information regarding its function we ha therefore determined the content of histone, as we as of the other constituents, in the nuclei from number of cells of different types by direct extractio from the isolated nuclei. A few of the results we abulated in our previous article[1], but no comment as made upon the evident differences in histone ontent until confirmatory work had been done on e subject. It has now been possible for us to xamine nuclei from further types of tissue, and we re presenting our new analytical results, together ith those previously obtained, in the accompanying ble.

Origin of nuclei	Percentage content of dried, lipoid-free nuclei		
	Histone	Nucleic acid	Chromosomin
Ox spleen	16	34	50
Fowl's erythrocytes	24	43	33
Calves' thymus glands	21	44	35
Cod sperm	12	28	60
Walker rat carcinoma	1·6	26	72·4
Mouse carcinoma 2146	3	32	65
Chick embryos	3	35	62

The main result of our investigation can at once be en from the above table. It is that in the two ypes of carcinoma tissue examined, and in the mbryonic tissue, the content of histone in the nuclei markedly smaller than in nuclei from normal ssue. We believe this to be the most significant sult of our experiments. Nevertheless, it should be oted that the nuclei from the carcinoma and embry- nic tissue contain a greater amount of chromosomin d, on the whole, a somewhat smaller amount of cleic acid than the nuclei from normal tissues.

In order to make the meaning of these results earer it is, perhaps, not superfluous to point out at, of the normal nuclei examined, those from the wl's erythrocytes can be regarded as homogeneous d entirely in the vegetative state. Those from the ymus gland, while not completely homogeneous, nsist to a preponderating degree of thymocytes hich, again, must be considered to be in the per- anently resting condition. On the other hand, the clei from the carcinoma tissue of both types, and om the embryonic tissue, are derived from cells dergoing frequent mitoses. We conclude from is that a high content of histone in the nucleus of a ll produces an inhibition of both the processes hich lead to mitosis and those which lead to the nthesis of the chromosomin necessary for the plication of the chromosomes.

The work described above is not sufficiently vanced for us to discuss all its implications at e present time, particularly its bearing on the ncer problem. There are, however, some tentative ggestions which can, we believe, be usefully made garding the mechanism by which the histone gulates the growth and division of a cell. As we ve pointed out, the histone is a protein with pro- unced basic properties and is, in fact, the only sic substance present in appreciable amount in the cleus. It appears to us to be an indisputable emical necessity for this base, when present in the cleus, to be in salt-like combination with the nucleic id, and it is therefore presumably this combination hich prevents both the synthesis of chromosomin d the division of the cell. So much seems to llow with certainty from our results. How this ect is produced can to some extent be visualized if e accepts the suggestion, which we have made ewhere[1], that the spindle which is formed in the ll during mitosis is composed of nucleic acid. By combination with the latter, the histone would, en present in sufficient amount in the nucleus, so alter the properties of the nucleic acid that the formation of a spindle would be impossible, and hence the processes which lead to cell division would be inhibited. On the other hand, in the absence of large amounts of histone part of the nucleic acid would combine with the basic groups of the chromosomin, causing the latter to be dispersed in the nucleus. In this condition, which would correspond with the resting state of the cell, the synthesis of chromosomin would occur, following which the chromosomes would begin to separate and the spindle to appear. Such a picture of the control of mitosis, although incomplete and possibly inaccurate in detail, serves a useful purpose in emphasizing the part played by the histone in cell division.

We desire to thank Mr. F. Pettigrew for carrying out the necessary implantations of the tumours, Dr. Greenwood and Miss Peace for supplies of fowl's blood and chick embryos, the Moray Research Fund for defraying the cost of the mice, and the Medical Research Council for a grant to one of us.

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OBITUARIES

Dr. F. J. W. Whipple

KEW OBSERVATORY has had a long line of superintendents, including Balfour Stewart and Charles Chree, and F. J. W. Whipple was a worthy member of it. He retired in March 1939 with the prospect of much useful scientific work ahead; but to the regret of his friends and old colleagues he died from heart failure on September 25 this year.

Francis John Welch Whipple was born on March 17, 1876. He was educated at Merchant Taylors' School and Trinity College, Cambridge. His university career was brilliant: he graduated as second wrangler and his Smith Prize paper was highly commended. For a few years he returned to Merchant Taylors' as mathematical master; then in 1912 he joined the Meteorological Office. For thirteen years he worked at the headquarters office in London, first as superintendent of the Instruments Division and then of the Climatology Division. In 1925, Dr. Charles Chree retired from the superintendentship of Kew Observatory and Whipple was appointed to succeed him, being promoted at the same time to the rank of assistant director of the Meteorological Office. This change was welcomed by Whipple for personal reasons, for his father, G. M. Whipple, had been superintendent of Kew Observatory during 1876-1893, and his maternal grandfather, Robert Beckley, had been on the staff in the eighteen-fifties and had designed the Kew self-recording meteorological instruments, which became almost as famous as the Observatory itself.

That Whipple had outstanding ability as a mathematician his university career had given evidence, and throughout his life he maintained his interest in mathematics; but he was also a physicist of no mean order, and the physical problems of meteorology, or rather geophysics, were entirely congenial to him. Whipple was not by nature original; but if in his reading or in conversation he came across a mathematical or physical problem he would devote time and energy to its solution. In this way seismology, atmospheric electricity and meteorological optics with their innumerable concrete problems interested him immensely and he became an authority on all these subjects. It was the exhibition by Sir Napier Shaw at the British Association meeting in Dublin of a diagram showing unexplained pressure waves on a microbarograph record which led to his outstanding paper on the great Siberian meteor, and it was the audibility in England of gun-fire on the Western Front during the War of 1914–18 which led directly to his major work on the transmission of sound, which has given us so much information about the temperature of the upper atmosphere. Practically the whole of Whipple's numerous publications deal with problems of this nature. Whether interest in such matters to the exclusion of more fundamental problems is in itself a good or a bad trait I am not prepared to say; but it played a great part in Whipple's success at Kew. Instead of being absorbed in his own investigations he took a personal interest in the work of the young men of science working under him, leading and helping them without any thought of credit to himself. The consequence was that the staff at Kew produced during Whipple's control a series of papers on seismology and atmospheric electricity which are of fundamental importance, and of which he and the Meteorological Office had every reason to be proud. With the passing of Dr. Chree, Kew Observatory ended an epoch of geomagnetic research; with Dr. Whipple commenced an epoch of research in seismology and atmospheric electricity which will be equally remarkable and has already enhanced the great reputation of Kew Observatory.

Whipple served on the National Committee for Geodesy and Geophysics of the Royal Society and was one of the British delegates to the International Geophysical and Geodetic Conference which met in Washington in September 1939. For a number of years he was chairman of the Seismological Committee of the British Association. He served on the Council of the Royal Meteorological Society and was president in 1937 and 1938. From 1930 until 1932 he was a member of the Board of the Institute of Physics.

From all this it will be seen that Whipple was an able man of science who was always ready to help and serve others; it is therefore not surprising that his death is felt in a very wide circle of friends. His wife died in 1926, as the result of a motor accident, and he leaves one son, who is following the scientific traditions of the Whipple family.

G. C. SIMPSON.

Dr. G. T. Bennett, F.R.S.

IN Dr. Geoffrey Thomas Bennett, who died after an operation on October 11, Cambridge loses one of her most characteristic sons: able in diverse ways, conscientious and thorough in all he was willing to undertake, and, for the most part, conservative in his scientific interests.

Born in London on June 30, 1868, he was at University College School, under Mr. H. W. Eve, and became in due course a scholar of St. John's College, Cambridge. Even then, the finish of the style of everything he wrote was remarked. In 1890 he was the senior wrangler, with distinction also in the second part of the Mathematical Tripos in 1891. It was in 1890 that Miss Fawcett, who, I believe, afterwards gave herself to the service of education in London, under the L.C.C., was placed above th senior wrangler. Soon after Bennett's consequen election to a fellowship at St. John's College, h followed a precedent set by A. G. Greenhill, an became mathematical lecturer and fellow at Emmanuel College. Here he continued to live, in room increasingly in tune with the rising style of amenit in Cambridge, and for many years, until his death had presided, as senior fellow, at the College dinner

Until after the War of 1914–18, mathematica lectures in Cambridge were organized for groups o colleges separately, and Bennett would lecture fo the group of which Emmanuel was part, possibly a enigma for some of his hearers; and he offered besides, an algebraical lecture on line-geometry ope to the whole University. His masterly instinct fo the geometry of mechanism was doubtless a bond o union with James Bennet Peace, who had graduate in 1887 from Emmanuel College, then teaching i the Engineering School (afterwards secretary of th Syndics of the University Press). In the afternoon he would often be seen sallying out on his summe or winter bicycle (according to the season), for whic the gearing had been arranged from a formula h gave to the cycle-agent, G. B. Howes. In the evenings he would often be found at the Universit concerts, and you would learn on inquiry that h had been giving attention to the mathematic aspects of music.

During the War of 1914–18 Bennett was for som time one of the party engaged, at Whale Island, i research in anti-aircraft gunnery; and passed to th gyrostatic compass department of the Admiralty a Slough, where he continued until after the armistice one remembers his characteristically trenchant remarks in regard to English knowledge of this compass. Since about 1920 he had withdrawn fro any overt connexion with the mathematical scho at Cambridge; but his touch could be recognize in various disclosures of his continuing interest mathematical curiosities of many kinds, includi models, of which he encouraged a fine collection Emmanuel College, and boomerangs. The late Maj MacMahon, for example, in his painstaking work regard to the regular division of the plane, was close touch with Bennett; and his help is ackno ledged in a certain striking book on school algeb It is to be expected that his drawers, when explore will bring many interesting mathematical results light.

In 1892, in more halcyon days than these, Cayl presented to the Royal Society a paper of 150 quar pages, devoted to the investigation of the primiti roots of a composite modulus (complex as well real). This was presumably developed from the ess he wrote for the Smith's Prize two years after h degree, and would amply suffice to establish h status as a mathematician. He became a memb of the London Mathematical Society in that yea of that Society he was later (1908–11) on the Counc and secretary during 1915–16. He became a fello of the Royal Society in 1914, and served on i council during 1936–38. At the time of his death was a fellow of University College, London.

The evidence of his interest in the kinematical que tions, in which he was superlative, may be indicat by reference to several of his published papers. In t *Philosophical Magazine* for June 1905, he wrote historical note in regard to the parallel motion marked by Sarrut, in 1853, giving a drawing of t mechanism employed. This seems not to be mention the enthusiastic lecture on "The Mechanical Con-ersion of Motion" given by Sylvester to the Royal nstitution in 1873, which begins with the Peaucellier ell of 1864. In the *Proceedings of the London Mathe-atical Society* we find "The Composition of Finite isplacements and the Use of Axodes" (1910), Deformable Octahedra" (1911), "The Skew Iso-ram Mechanism" (1913), and later, "The Three-bar extic Curve" (1920). But a more abstract paper of 910 is on the double six of lines on a cubic surface; an appendix to this he suggests a diagram, to hich he returns in 1911, for representing all the nes; this is in fact a graphical form for Steiner's set three complementary systems (1856), to which he oes not refer.

In a university which accepts the double task of ving instruction and care to all who are working r its examinations, and of fostering a lively interest the development of knowledge, many of the best rains among the teachers will be drawn, by loyalty or discipline, into the former task; and those who feel the importance of the latter may have a hard struggle. It is one of the complaints one has so often heard about some of the provincial universities. In the comparatively easier circumstances at Cambridge, one may say that Bennett made a wise compromise. The writings which he has left will remain as evidence of his great power and ability.

H. F. BAKER.

WE regret to announce the following deaths:

Sir Robert Falconer, K.C.M.G., president of the university of Toronto, aged seventy-six.

Prof. I. Traube, formerly of the Technische Hochschule, Berlin, and recently of Edinburgh, a well-known physical chemist and a pioneer in the field of surface chemistry, aged eighty-four.

Prof. Einar Lönnberg, the well-known Swedish geologist, died on November 21, 1942, and not on October 21, 1943, as stated in NATURE of November 6.

NEWS and VIEWS

oyal Society: Medal Awards

HIS Majesty the King has been graciously pleased approve the recommendations made by the ouncil of the Royal Society for the award of the o Royal Medals for the current year as follows: Sir Harold Spencer Jones, Astronomer-Royal, for s determination of the solar parallax and of other ndamental astronomical constants; to Dr. E. B. iley, director of H.M. Geological Survey, for his stinguished contributions to the knowledge of ountain structure and his studies on the tectonics vulcanism.

The following awards of medals have been made the president and Council of the Royal Society: pley Medal to Sir Joseph Barcroft, emeritus pro-ssor of physiology in the University of Cambridge, his distinguished work on respiration and the spiratory function of the blood; Davy Medal to of. I. M. Heilbron, professor of organic chemistry the Imperial College of Science and Technology, ndon, for his many notable contributions to organic emistry, especially to the chemistry of natural oducts of physiological importance; Sylvester dal to Prof. J. E. Littlewood, Rouse Ball professor mathematics in the University of Cambridge, for mathematical discoveries and supreme insight in analytical theory of numbers; Hughes Medal to of. M. L. E. Oliphant, Poynting professor of ysics in the University of Birmingham, for his tinguished work in nuclear physics and mastery methods of generating and applying high potentials.

tirement of Prof. O. T. Jones, F.R.S.

THE retirement of Prof. O. T. Jones from the oodwardian professorship of geology at Cambridge September 30 took many of his friends by sur-se, so little sign did he show of his approach to age limit set by the University Statutes. He nt to Cambridge from Manchester in 1930, well ed by his researches in Wales to foster that interest Lower Palæozoic stratigraphy and physiographical oblems which has long been associated with the mbridge school of geology. In this work he was prodigal of personal effort, and the intense fervour with which he threw himself into unravelling the complexities of 'slumping' in the Silurian rocks of Denbighshire is not likely to be forgotten by his staff and students of that time. By no means, however, did he limit himself to these fields, but continually found fresh interests to expound in which his insight seldom failed to bring out new points of capital importance. Indeed his tenure of the chair will be notable for its encouragement of interest in allied subjects; he established a close liaison with experimental geophysics and he was equally ready to collaborate with botanists and archæologists over the problems of the Fenland and Breckland of East Anglia, and with engineers in the laboratory study of stressed rocks.

That Prof. Jones's broad outlook was not limited to research was shown by the incorporation of practical work on sediments into the elementary geological course at Cambridge, with the establishment of a special laboratory under Mr. Maurice Black. Nor was it geographically circumscribed; in particular, his intercourse with the United States on Lower Palæozoic and geophysical problems, especially through the collaboration of Prof. R. M. Field of Princeton University, should continue to bear fruit in promoting scientific amity between the two shores of the Atlantic. Though war sadly depleted his department of students, it was quite unable to quell his determination to carry on field-work, and it is confidently hoped that his years of retirement will see the publication of further important research on the Lower Palæozoic of his own country of Wales.

Abraham Colles (1733–1843)

NOVEMBER 16, 1843, marks the centenary of the death of Abraham Colles, the eminent anatomist and surgeon of Dublin. He was born in 1773 at Milmont, near Kilkenny, and received his medical education at the University of Dublin, where he obtained his diploma at the Royal College of Surgeons in Ireland in 1795. He afterwards went to Edinburgh, where after two winter sessions he became M.D. He then made a journey, most of the way on foot, to London, where he made the acquaintance of Sir Astley Cooper, whom he assisted in his work on hernia and first became impressed with the inefficiency of the older modes of teaching anatomy. In 1797 he returned to Dublin and set up in practice. Two years later he commenced clinical teaching and also lectured on surgery in his private rooms. In 1804 he was appointed professor of anatomy and surgery at the Royal College of Surgeons in Ireland and held that post for thirty-two years. He was also surgeon to Steeven's Hospital, and was twice president (in 1802 and 1830) of the Royal College of Surgeons in Ireland. Selections from his works consisting chiefly of "Practical Observations on the Venereal Disease", in which he maintained that syphilitic children nursed at the breast often infect wet nurses but never their own mother—an observation afterwards known as Colles's law—appeared in the New Sydenham Society's publications in 1881 under the editorship of Robert McDonnell. His name has also been attached to a fracture of the lower end of the radius, which he described in 1814 in the *Edinburgh Medical and Surgical Journal.*

Theodor Engelmann (1843–1909)

THEODOR WILHELM ENGELMANN, an eminent German physiologist, was born at Leipzig on November 14, 1843, the son of a well-known publisher. He received his medical education at Jena, Leipzig, Heidelberg and Göttingen, and qualified at Leipzig in 1867. Directly after qualification he became assistant to Donders at the Physiological Institute at Utrecht, where he was appointed professor of general biology and histology, and succeeded Donders in the chair of physiology in 1888. In 1897 he succeeded Du Bois-Reymond as professor of physiology at Berlin, where he died on May 20, 1909. His most important work was the discovery of the cones and pigment cells of the retina. Besides studying the mechanics and thermodynamics of muscular contractions, he published works on ciliary movement (1868), spectrophotometric observations and an obituary of Helmholtz (1897). He was also co-editor of *Archiv für Physiologie.* He was well known to physiologists in Great Britain, where he was elected an honorary member of the Physiological Society in 1898. He was elected an honorary member of the American Physiological Society in 1904.

Plans for International Trade

UNDER the title "New Plans for International Trade", the Institute of Statistics, Oxford, has issued a Supplement to its Bulletin (No. 5, Vol. 5) reviewing the principles embodied in the proposal of the British Treasury for an International Clearing Union and that of the American Treasury for an International Stabilization Fund. An introductory paper by the editor points out that international trade exists because some goods can be produced relatively cheaper in some countries than in others, and the aim of an international currency plan must be to lay down a code of rules which countries agree upon and can be relied upon to apply in international trade and finance in different circumstances. The test questions are : (1) Are adequate provisions made for furnishing each country with liquid reserves for restarting international trade after the disruptions of the War and pre-war periods, as a means of enabling all countries to partake in international trade and reap the benefits of an exchange or loan of goods ? (2) How can we prevent countries from becomin illiquid again ? (3) How can we keep check upo and regulate short-term borrowing and lending, they are a disruptive element ? (4) How can w make an international system workable and com patible with any form of social-economic organizatio and any internal policy which member countri might wish to adopt ? (5) Can we introduce a stead expansionist force into international trade, whic would neutralize, or, if necessary, over-compensat the effects of restrictionist policies of some memb States on the rest of the trading community ?

Discussing the British plan, which purports t exert pressure on any country whose balance of pay ments with the rest of the world is departing fro equilibrium in either direction, E. F. Schumach states that the plan aims at more than equilibriu but does not fully face the issues of exchange contro He concludes that it would create internation liquidity on a generous scale—with all that th implies for the freedom and growth of internation trade—and that it is imbued with a spirit of expansio and is groping, though not very successfully, for way and means to create an international monetar mechanism favourable for expansion. The America plan does not seem to offer a workable system. It principal defect is a quantitative one. Even if th Stabilization Fund were considerably enlarged, ther would remain the difficulty that the Stabilizatio Fund technique itself imposes a more or less rigi maximum limit upon individual surpluses.

In the following paper, M. Kalecki and E. F Schumacher propose an amendment to the Britis plan in which an orderly supply of purchasing powe to deficit countries through long-term lending by th International Investment Board is made possibl The concluding paper, by T. Balogh, on "The Foreig Balance and Full Employment", examines furthe the question of how any single country can b enabled to maintain stability at full employment i a world system in which unemployment or inflatio exists in other countries.

Dehydration of Food by Radio-Frequency Energy

THE Industrial Electronics Division of the Feder Telephone and Radio Corporation, co-operating wit the Office of the Quartermaster-General of the Unite States Army, has developed a process of dehydratin food by means of radio-frequency energy. The pro cess is described briefly by Vernon W. Sherman i a recent article (*Elec. Comm.*, **21**, No. 2; 1943 The electronic dehydration method not only mak it possible to remove 99 per cent of the moistu content but it also permits this high degree of d hydration after the vegetables have been compress into a small block or briquette 6 in. × 3 in. × ¾ i Compression of vegetables prior to total dehydrati is an unprecedented procedure, other processes r quiring exposure of as much of the vegetable surfa as possible to facilitate evaporation. With all b one per cent of the moisture removed, it is possib to pack all types of dehydrated vegetables in seal containers and transport them to any part of th world without danger of decomposition. The leng of time vegetables may be kept in good conditi increases very greatly as the moisture conte approaches one per cent. Evidence now indicat that vegetables dehydrated by the electronic meth will not deteriorate over a period of one to two yea even in hot, humid climates.

Vegetables reconstituted after electronic dehydra-on may be cooked and served in the same way as esh vegetables. Reconstitution is accomplished by aking the vegetables in water. They then return to eir original colour and consistency and retain their ormal taste and aroma. The vitamin content of ectronically dehydrated vegetables is especially high, e apparently to the much shorter processing time. he exact method of dehydration cannot be dis-osed at present. Briefly, however, 80 per cent of e moisture is removed by conventional methods, aving the vegetables pliable but without formation 'case hardening'. The vegetables are then com-essed into bricks and the remaining moisture is moved electronically, after which they are ready be wrapped in paper, wax coated, packed and ipped. The whole procedure is well adapted to tomatic straight line production. Laboratory sults show that one pound of water may be re-oved electronically with less than one kWh. of ergy, a figure which is economically good in com-arison with other methods. In addition to vege-bles, dried whole milk also has had its moisture ntent reduced electronically from two per cent to e per cent. This small difference makes it possible ship dried whole milk without danger of its butter t content becoming rancid. Unlike dried skim milk, ied whole milk can be reconstituted to be as latable and nutritious as fresh milk. Apart from e importance of this electronic dehydration achieve-ent, the process represents another of the many tgrowths of fundamental research and develop-ent in industry. Electronic dehydration of food-uffs was undertaken by the Federal Telephone and adio Corporation as a co-operative and non-munerative project to aid in the war effort.

ecent Advances in Public Health Measures

FROM the *Fight Against Disease*, 31, 1943, issued y the Research Defence Society, we learn that six ti-vivisection societies reported in the last pre-war ar an income of more than £50,000. The Research efence Society, on the other hand, got along gorously in 1942 on about £500. Its report for 42 gives interesting details about the prevention a wide outbreak of smallpox when it appeared in otland in May 1942. Some of us who had to pass rough Glasgow in July of that year remember well e encouraging spectacle of the people crowding to e vaccination centres. About 500,000 people were ccinated and by July 31, thirty days after the ccination campaign had begun, the last case of allpox was reported. The report also deals with e remarkable results of immunization against phtheria. There must be few intelligent people ho will refuse their children this inestimable benefit. any are still disposed to do so, they should read T. Russell's report, published by the Medical esearch Council, on the epidemiology of diphtheria ring the last forty years.

The Ministry of Health, Ministry of Information nd Central Council for Health Education send us mples of the publicity material issued by them r use in the campaign against diphtheria. Sir ilson Jameson calculates that diphtheria kills meone in Great Britain every three or four hours d every twenty minutes sends a child to hospital. he number of children who have been protected is ot enough. Children under five are most likely to iffer. It is astonishing that parents can still fail to take their children to receive this safe, simple treatment, obtainable free through any medical officer of health. It should be obtained now, before the winter comes.

The Medical Research Council sends us another valuable memorandum (War Memorandum No. 10) entitled the "Medical Use of Sulphonamides". This deals with the chemistry, pharmacology, dosage, toxicity and supply of these drugs and with the treatment of specific infections with them. They have been given so many names that the lists here given of the alternative names of each compound will help to prevent confusion. Appendixes deal with the estimation of the concentration of sulphonamides in the body fluids, with tests for sulphonamide-resistance in bacteria and with the sterilization of sulphanilamide powder.

Authority in Medicine

IN the Linacre Lecture delivered at St. John's College, Cambridge, on May 6, 1943, Prof. Major Greenwood, after a graceful tribute to previous lecturers including Sir Thomas Watson, Sir Humphry Rolleston, Sir George Newman and Dr. W. W. C. Topley, dealt at length with the doctrine of Galen, with whom Linacre was familiar, and particularly his work on epidemiology, general hygiene and medical psychology. Prof. Greenwood regards Galen's epidemiological influence as bad because he overrated the creative power not of Nature but of his own intelligence, and never considered alternative hypotheses as was done by John Graunt fifteen hundred years later. Galen's work on personal hygiene, which Prof. Greenwood regards as the most readable of his books, contains an admirable description of practical dietetics, physical training and the Horation philosophy of life. As regards medical psychology, according to Prof. Greenwood, Galen was in advance of any medical writers of the Renaissance. Passing on to the subject of experimental epidemiology, in which he was associated with Dr. Topley for more than fifteen years, Prof. Greenwood points out that in acute infectious diseases like typhus pure laboratory work has created an applied science of immunology which owes nearly everything to the experimental method. The lecture ends with an encomium of the late Sir Walter Fletcher, secretary of the Medical Research Council, of whom he says that "he fought for and secured a scientific freedom in state-aided medical research".

Archæological Research in Ulster

IN 1935 the Government of Northern Ireland agreed to pay 60 per cent of the wages of unemployed labourers engaged for the purpose of archæological excavation, up to a total sum of £500. Later the percentage was raised to 80. This method of dealing with the then acute problem of unemployment was to some extent copied from that already in operation in the Irish Free State. As a result, much valuable excavation was undertaken in 1935 and succeeding years, and important information has come to light. More particularly have the various museums and archæological societies, which have taken advantage of the opportunity, concentrated on the study of the North Irish megalithic monuments. Ireland's geographical position is such that the island was a very important area in the days when the megalith builders were wandering about parts of western Europe. Northern Ireland has its full share of these monuments. Then again, Northern Ireland has yielded important Mesolithic industries, the study of which is still incomplete. Nor must relics of later periods be forgotten, and crannogs, earth-forts, etc., have received attention. Further, it has been realized that excavation without subsequent publication is of little worth.

Naturally, much of the new information has found its way into the older well-known archæological journals and proceedings, but special reference must be made to the *Ulster Journal of Archæology*, which has just published its sixth volume, containing an account by the editor of the archæological achievement of the last ten years. The reader will certainly find this publication eclectic in its interests, and much curious and interesting information on subjects ranging from prehistoric to modern can be culled from its pages. It is to be regretted that England, during the periods of acute unemployment, did not follow the lead given by Ireland. Of course, here, as indeed in Ireland too, museums and local archæological societies make grants for the purposes of excavation. But direct Government aid of the kind mentioned above gives an immense fillip to such work, and there is a direct return to the body politic, which is scarcely the case when the money is merely spent in 'doles'. The Irish method at least means that more becomes known of the country's past.

Labour in the Building Industry

A RECENT broadsheet (No. 212) issued by Political and Economic Planning contains a close analysis of the organization of the labour force in the building industry in Great Britain, nationally, on the site and in the trade unions, which represents part of a wider study of industrial relations which was undertaken before, but was interrupted by, the War. The analysis covers all sizes and types of unit, from the very large firms down to the small firms and their groups. It gives a clear picture of the organization of labour on the site including the organizing personnel, the recruitment of foremen and the part played by the trade unions, as well as of the organization of labour in the unions, including the federation branch, the executive committee, the National Joint Council, the rates of wages and payment by results. In the post-war period the latter question will be linked with the questions of prefabrication and of new and more flexible types of training, and the essential changes of practice are unlikely to be secured without a sense of urgency and without Government intervention which can be visualized only as part of a great plan of guaranteed employment for the building industry. With guaranteed employment all sorts of technically desirable changes may well become more acceptable, but the goodwill of the trade unions is indispensable, and this can only be obtained by full and frank consultation, and by democratic discussion both at the national level, in the localities and on the site.

Scientific Societies of North America

THE U.S. National Research Council has produced a fourth edition of its "Handbook of Scientific and Technical Societies and Institutions of the United States and Canada" (Bull. 106, Jan. 1942. Washington, D.C.: National Academy of Sciences). This well-bound volume of 389 large pages contains information relating to 1,269 bodies in the United States and its dependencies, and 143 in Canada, which "contribute to the advancement of knowledge through their meetings, publications or oth resources", and are included in the wide fields natural sciences, technology and more general orga izations supporting scientific research. Agencies the Federal Government, organizations directly co trolled by universities, bodies which act throug grants rather than direct by conducting research, an industrial research laboratories are excluded. In eac case there are given the name and address of th organization, the chief officers, a brief history, it objects, particulars of membership, meetings, researc funds and medals, and serial publications. The dat have been compiled from information received fro the bodies concerned. The entries are arranged alph betically in two sections, one for the United Stat and one for Canada. There are subject and personn indexes for each section. The only comparable pu lication in Great Britain is the "Official Year-Boo of the Scientific Societies of Great Britain and Ir land", published by Messrs. Charles Griffin and Co Ltd., for many years, but discontinued since th beginning of the War. Such reference books ar of much value in the library and elsewhere.

Rare Scientific Books

CATALOGUE 8 (Spring 1943) issued by Schuman' 20 East 70th Street, New York, contains 485 item the great majority of which are of medical interes but including a number of non-medical scientifi works as well. Special mention may be made of th following: several works by Vesalius including th third edition of the "Fabrica", the first edition Casserio's "Tabulæ Anatomicæ" (1627), Fallopio' "Institutiones Anatomicæ" (1585), the first editio of Acosta's "Herbal" (1578), Cesalpino's "D Plantis" (1583); Fracastor's "Opera Omnia" (1555 the first edition of Conrad Gesner's "Surgical Tracts (1516–65), Hans Sachs' folk poem (*c.* 1550), the firs edition of Guido Guidi's work on surgery (1544), th first edition of Cockayne's "Leechdoms" (1864–66 the first edition of Morgagni's "De Sedibus et Caus Morborum" (1761). The non-medical works includ the first edition of Goethe's "Metamorphose d Pflanzen" (1790), the first edition of Lyell's "Ge logical Evidence of the Antiquity of Men" (1863 the first edition of Newton's "Optics" (1704) an the first edition of the "Origin of Species" (1859 and Francis Hauksbee's "Physico-Mechanical Exper ments on various Substances" (1709).

Announcements

A SPECIAL meeting to commemorate the life an work of Nikola Tesla will be held at the Institutio of Electrical Engineers on November 25, at 3 p. At the meeting a lecture, with examples of Tesla' experimental work, will be delivered by Dr. A. P. Fleming, director and manager, Research an Education Departments of Messrs. Metropolita Vickers Electrical Co., Ltd.

IN reviewing Prof. J. C. Slater's "Introduction Chemical Physics" in NATURE of October 30, p. 48 the price of the book quoted was that of the time issue, namely, 33*s.*; we are informed by the McGraw Hill Book Co., Inc., that the current price is 35*s.*

ERRATUM. In NATURE of November 6, p. 53 col. 2, line 1, for "flies is not due to mechanic inability to reach the goal", read "flies is due mechanical inability to reach the goal".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Recognition of *Rh* Genotypes in Man

In a recent communication, two of us[1] described a serum which we think discloses the genotype of half the persons who are homozygous for the blood group factor *Rh*. This serum, *St*, agglutinates the red cells of about 80 per cent of people, including the 15–16 per cent who are *Rh*-negative and all the 48 per cent who are heterozygous, *Rhrh*. It fails to react with 20 per cent, all of whom must be homozygous *RhRh* and be about half the total number of homozygotes (about 38 per cent of all people).

It is certain that multiple allelomorphs of the *Rh* gene occur, and to begin with three may be assumed, Rh_1, Rh_2 and *rh*. We suggested that *St* negative (*St*−) people are Rh_1Rh_1. If *St* fails to agglutinate the cells of persons with the Rh_1 gene it must react with all other frequent allelomorphs, Rh_2 and *rh*, in order to make up its 80 per cent of positive reactions.

Recently we have found in the serum of the mother of an erythroblastotic infant a different type of rare anti-*Rh* agglutinin. This serum, which we call *K*, is positive with about 30 per cent of the population, and Dr. C. V. Harrison has sent a second serum, *J*, which gives identical results. We have used *St*, *K*, *J* and normal anti-*Rh* sera to examine the blood of 281 unselected donors (205 at Cambridge and 76 at Sutton) as well as members of families we were investigating for the *Rh* factor in connexion with erythroblastosis fœtalis. The results from the two unselected groups together are:

	St+	*St*−		*KJ*+	*KJ*−		*KJ*+	*KJ*−
Rh+	174	52	*Rh*+	84	142	*St*+	83	146
Rh−	55	0	*Rh*−	2	53	*St*−	3	49

It is seen that (*a*) *Rh*− blood is *St*+; (*b*) *Rh*− blood is nearly always *KJ*−; (*c*) *St*− blood is nearly always *KJ*−. Apart from the five exceptions, it seems that *KJ* can react neither with Rh_1 nor *rh*, and must, therefore, react with Rh_2 to achieve its 30 per cent of positives. (The estimated frequency of the genotypes containing Rh_2 is very near to 30 per cent.) Besides the five exceptions in the 281 unselected bloods, two of them *Rh*−*St*+*KJ*+ and three *Rh*+*St*−*KJ*+, a further example of each type was found in the 139 family samples.

We suppose that the genes so far discussed cause the following reactions:

		Antisera		
		Rh	*St*	*KJ*
	Rh_1	+	−	−
Genes	Rh_2	+	+	+
	rh	−	+	−

If this is true, it follows that Rh_1rh blood must be *Rh*+*St*+*KJ*−. No combination of two of these allelomorphs can make either *Rh*−*St*+*KJ*+ or + − +. The first case, − + +, could be explained by the presence of a rare gene reacting with *KJ* and not with *Rh*; we may provisionally call this Rh_x. Since it is so rare, it seems certain that in our three examples of this type of exception the gene is not in the homozygous state (for if it was present here in the homozygous state it can be calculated that the frequency of Rh_xrh, − + +, would be about 1 in 15 of all persons). The genotype cannot be Rh_1Rh_x or Rh_2Rh_x, since both of these would be *Rh*+ (Rh_xRh_y, see below, would also be much too rare). The genotype must therefore be Rh_xrh. American workers have described anti-*Rh* sera which react with 2 per cent of people who are *Rh*− with the anti-*Rh* sera most commonly found. It is possible that such a serum would be positive with this genotype Rh_xrh. Although Rh_xrh will be *St*+ by virtue of its *rh* gene, there is evidence that Rh_x also reacts with *St*. If *St* serum is titrated with *rhrh* blood and Rh_1rh blood, the red cells representing the double dose of the *St*-active *rh* gene agglutinate at a much higher dilution (eight times on the average) than do the Rh_1rh cells representing a single dose of the *St*-active gene. Two of our examples of Rh_xrh have been titrated and they are both at the top of the double-dose class.

If the gene Rh_x does react with *St*, as seems likely, then to explain the second class of exception, + − +, a further allelomorph Rh_y which is *St*−*KJ*+ must be postulated. The genotype of the four exceptions of this kind cannot with reasonable probability be Rh_yRh_y. It cannot be Rh_yrh, Rh_2Rh_y or the rare Rh_xRh_y, for all these would be *St*+. This leaves only Rh_1Rh_y. It cannot be said at this stage whether Rh_y is *Rh*+, for Rh_1 may be wholly responsible for the *Rh*+ reactions of these four bloods; no help is given by titration, for anti-*Rh* does not make such a distinction as does *St*. The extended scheme is:

		Antisera		
		Rh	*St*	*KJ*
	Rh_1	+	−	−
	Rh_2	+	+	+
Genes	Rh_x	−	+	+
	Rh_y	?	−	+
	rh	−	+	−

Only a rough estimate of the frequencies of Rh_x and Rh_y can be made since the total figures are small for such infrequent genes. For what they are worth they may be derived:

$$Rh_xrh = 0{\cdot}007 \text{ and } Rh_x = \frac{0{\cdot}007}{2 \times \text{frequency of } rh} = 0{\cdot}009 \text{ or } 0{\cdot}9 \text{ per cent}$$

$$Rh_yRh_1 = 0{\cdot}011 \text{ and } Rh_y = \frac{0{\cdot}011}{2 \times \text{frequency of } Rh_1} = 0{\cdot}013 \text{ or } 1{\cdot}3 \text{ per cent}$$

The frequency of Rh_x must be deducted in calculating that of *rh*, and the frequency of Rh_y deducted similarly in calculating Rh_1. The proportion of *Rh* negatives among persons examined by us is 722 out of 4,618, or 15·63 per cent. Taking the square root, we have 39·5 per cent as the combined gene frequency of *rh* and Rh_x. Using the frequency estimated above for Rh_x this gives

rh	38·6 per cent
Rh_x	0·9 ,, ,,

Similarly, the proportion of *St* negatives observed is 97 out of 499, or 19·44 per cent. Taking the square root, we have 44·09 per cent as the combined gene frequency of Rh_1 and Rh_y, giving

Rh_1	42·8 per cent
Rh_y	1·3 ,, ,,
leaving Rh_2	16·4 ,, ,,

If we group together as "the rest" all the genotypes which we cannot recognize serologically, we can compare observed and expected frequencies:

	+ − −	− + −	+ + −	− + +	+ − +	+ + +
	Rh_1Rh_1	*rhrh*	Rh_1rh	Rh_xrh	Rh_1Rh_y	The rest
Observed per cent	17·4	18·9	33·1	0·7	1·1	28·8
Expected per cent	18·3	14·9	33·0	0·7	1·1	31·9

The close fit is good confirmation that the genotypes do react with these three sera as we suppose. The fit of Rh_1rh is particularly important as the expectation could be calculated before *KJ* serum was discovered. Significant also are the children of matings Rh_1Rh_1 × *rhrh*, since all must be Rh_1rh. We have examined nine such families with sixteen children all

$Rh+St+KJ-$. The probability that all sixteen would be *KJ* negative by chance is $0{\cdot}63^{16} = 0{\cdot}0006$ (the chance of an $Rh+$ person being $KJ-$ is 0·63). Twenty-five families so far examined have shown no discrepancies. By the use of normal anti-*Rh*, *St* and *KJ* sera the genotypes Rh_1Rh_1, Rh_1rh, $rhrh$, Rh_xrh and Rh_1Rh_y, 68 per cent of the total, can be recognized. This is of prognostic importance in families in which erythroblastosis fœtalis has occurred; and it should increase the usefulness of the *Rh* blood groups in linkage studies.

Since this work has been done, we have received a paper by Wiener and Landsteiner[2] giving frequencies for the genes Rh_1 48 per cent, Rh_2 16 per cent and *rh* 36 per cent. These frequencies were derived from the behaviour of sera quite different from *St* and *KJ*. In a personal communication at the same time, Wiener says that they now have papers in the press demonstrating six distinct allelomorphs. We are at present calling our fourth and fifth allelomorphs Rh_x and Rh_y, in the hope that a name and place is ready for them in Wiener's scheme.

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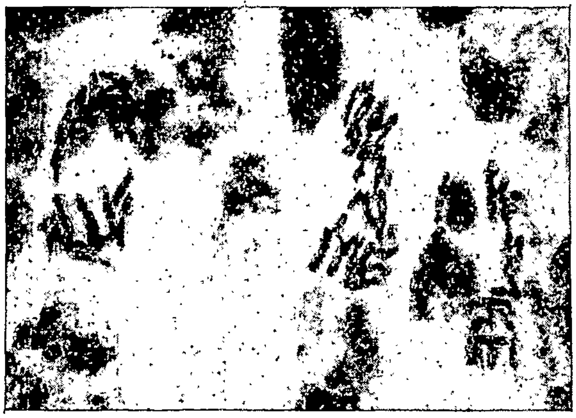
Chemical Control of Mitosis

A CONNEXION between the mode of action of carcinogenic and of polyploidogenic reagents has frequently been postulated[1,2], but the crucial test of the induction of polyploidy in plants by a typical carcinogenic hydrocarbon has so far not been recorded. Patton and Nebel[3], for example, report that dibenzanthracene causes increase in the size of the prophase nuclei in the root tips of Zea, but state that no abnormality of mitosis could be observed. It was therefore with some surprise that we found recently on examining the root tips of rye seedlings, which had been growing in water containing crystals of 1.2.5.6 dibenzanthracene, a striking polyploidogenic effect. This did not occur in the control with water alone.

We repeated the experiment, but found only normal growth, and it was some time before we traced the reason for the first result. At that time we had also been working with organic mercury compounds such as are used for dusting seeds to prevent fungal attack. These compounds are crystalline solids, but some have an appreciable vapour pressure and even at room temperature give off a toxic vapour. This led us to suspect that the laboratory air may have been vitiated and we repeated the first experiment in an atmosphere which was in equilibrium with solid ethyl mercuric chloride. The result was precisely as in the first experiment, namely, definite chromosome doubling.

Further trials showed that a very dilute solution of ethyl mercuric chloride gave the same result and had the great convenience that the dosage could be controlled.



PRONOUNCED POLYPLOIDY IN ROOT TIP OF RYE, GROWN IN A MIXED SOLUTION OF 1·75 P.P.M. DIBENZANTHRACENE AND 0·25 P.P.M. ETHYL MERCURIC CHLORIDE. SEPARATE SOLUTIONS AT THESE CONCENTRATIONS GAVE ONLY DIPLOID NUCLEI ($2n = 14$). (× 750.)

Stock solutions of ethyl mercuric chloride and dibenzanthracene were made by dissolving 1 mgm. of each chemical in alcohol and diluting to the required proportions with tap water. Both substances were difficult to dissolve in water alone and this procedure was necessary to obtain exact dilutions. The final mixtures contained 0·4 per cent alcohol. The dibenzanthracene which is soluble in water only to the extent of 0·001 part per million[4] was a colloidal suspension and therefore saturated; the ethyl mercuric chloride was a clear solution. In a supplementary experiment, as reported by Levan and Ostergren[2] for colchicine, we found that this trace of alcohol showed a slight antagonism and lifted the lower threshold value of action. The accompanying table summarizes our results on the action of these compounds on the root tips of rye seedlings, after 48 hr. treatment at 22° C.

Parts per million of water		Effects*		
Dibenz-anthracene	Ethyl mercury chloride	*c*-Mitosis	Toxicity	Polyploidy
1	*0*	—	—	—
0	*1*	+	++	—
1	*1*	—	++	—
1·5	*0·5*	+	++	—
0	*0·5*	+	+	+
1·75	*0*	—	—	—
0	*0·25*	—	—	—
1·75	*0·25*	+++	—	++

* The *c*-mitosis column shows the degree of spindle disturbance—the toxicity is measured in inverse proportion to the number of accumulated active nuclei after 48 hours.

It will be noticed that only very minute concentrations of the reagents are involved and that there is a limited range of effectiveness. Dibenzanthracene alone has no effect on mitosis at any concentration while ethyl mercuric chloride alone has a slight effect at 0·5 part per million. Ethyl mercuric chloride alone has no effect at 0·25 part per million, but in conjunction with dibenzanthracene the polyploidogenic effect is pronounced (see accompanying illustration).

Evidently the ethyl mercuric chloride is the direct polyploidogenic agent and the dibenzanthracene facilitates its action. The observation by Lisle[5], which we have confirmed, that dibenzanthracene reduces the ability of lipoids to inhibit the oxidation of fats may show how this comes about.

It is too early to decide the exact role of these two reagents, and systematic study of pairs of simila substances is needed, but this example of a complementary action suggests a new line of attack in both chromosome and cancer research.

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Relapsing Fever and *B. proteus X Kingsbury*

WHILE in Ethiopia with a mobile bacteriological laboratory, it was noted that there was an association between the findings of blood spirochætes and an agglutination of *B. proteus X Kingsbury*. Of 650 cases in which Borrelia were found and which were tested for agglutinations, 211 gave agglutination of *Kingsbury* in dilutions of 1/100 and more. An examination of specimens submitted for Kahn test failed to reveal a corresponding high level in 'normal' individuals, and the testing of malaria cases disposed of the possibility of an 'anamnestic' type of reaction.

A series of 110 cases in which spirochætes were found was followed up with agglutination reactions every fourth day. These cases were for the most part under arsenical treatment. Some had relapses and some died. Their responses to *B. proteus X Kingsbury* were as follows:

Clinical course	Agglutination of *Kingsbury* in 1/100	
	Positive	Negative
No relapse	6	35
One or more relapses	22	27
Deaths	—	20

In those relapsing cases which responded there was a progressive rise of titre, in one case reaching 1/6400. Immediately after what was to prove the last relapse there was a rapid fall in titre; and a month after it had completely disappeared, that is, less than 1/50.

We had cases showing agglutinations in which spirochætes were never demonstrated. Some of these were treated empirically as relapsing fever, and recovered, but some others gave a 'typhus' picture.

These cases were all in the highlands where Ornithoiorus is unknown, and judging by the parallelism with epidemic typhus were probably louse-borne.

Unfortunately, the exigencies of the Service did not permit of further investigation.

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Glycogen in Adipose Tissue after Insulin Injection

WHEN insulin is injected into a normal rat of about 100 gm. maintained on an ordinary diet, a transient appearance of glycogen is demonstrable in the adipose tissue. If, after the glycogen has disappeared, the insulin injection is repeated, new transient deposition of adipose glycogen is induced. It should be added that different types of adipose tissue differ quantitatively from one another in ability to store glycogen following insulin treatment. In general, deposition occurs most rapidly in the brown interscapulary adipose, less rapidly in mesenterial adipose, and least rapidly in other adipose stores. Seasonal fluctuations, too, are of importance. In summer, the demonstration of deposition necessitates no particular precautions; in winter, deposition occurs less rapidly and then only if the animals are maintained above 21° C. on a diet of high calorific value, and if relatively large doses of insulin are administered. Protamin-zinc-insulin is of greater effectivity than ordinary insulin. The adipose tissue of rabbits is less active[1]. The effect of insulin in this animal is smaller and only detectable after sugar feeding.

Representative experiments which illustrate the above effects are given in Table 1.

TABLE 1.

Month	Prot.-Zn.-Insulin	Duration of exp. (hr.)	Glycogen gm./100 gm. adipose tissue			Blood sugar	No. of expts.
			Intersc. fat	Mesent. fat	Total fat		
March/April	2×1 unit	7	0·30	0·15	0·052	74	10
Feb.	2×3 units	7	0·29	0·12	0·045	62	19
	Controls	7	0·03	0	0	118	15

July. Administration of 1 × 1 unit prot.-Zn.-insulin

Glycogen gm./100 gm. in adipose tissue after	1½	3	4	5	6	7	9–10
	hours						
Interscap. fat ..	0·19	0·14	0·16	0·21	0·28	0·40	0·08
Mesent. fat ..			0·05	0·12	0·14	0·15	0·04
Total fat				0·04	0·04	0·07	0

Each value quoted represents the average of at least four experiments. Controls in seven random tests showed no glycogen in adipose tissue.

Glycogen deposition always occurs in adipose tissue when fat synthesis from carbohydrates is taking place, for example, following intake of a carbohydrate-rich meal after a period of fasting[1], following carbohydrate abundance without previous fasting or when animals are subjected to alternate periods of hunger and feeding as in the experiments of MacKay and Drury[2]. The occurrence of stable fat deposition in man following prolonged insulin treatment has long been known[3]. MacKay and collaborators[4] have carried out a precise study of this effect in rats. It seems justifiable, therefore, to assume that the glycogen deposition in adipose tissue following injection of insulin is merely a preliminary of fat deposition.

The observation has repeatedly been stressed that the insulin effect is associated with stimulation of appetite for carbohydrates and consequent increase in the carbohydrate intake. It was of importance accordingly to ascertain whether the deposition of glycogen in adipose tissue following insulin administration is secondarily induced and a result of increased carbohydrate intake, or a primary effect of the direct action of insulin on the adipose. The following experiments seem to support the latter explanation alternative: (1) In summer experiments, glycogen deposition in interscapulary adipose is already demonstrable within one hour of insulin injection. (2) Glycogen deposition in adipose tissue occurs rapidly following insulin injection also in rats maintained on a protein-high diet (70 per cent casein, 20 per cent carbohydrates, 10 per cent fat), although appetite and food intake in these animals, as is well known, are not stimulated by insulin[5]. Moreover, glycogen deposition in interscapulary adipose is induced in such rats, even if they are fasted on the day prior to, as well as during, the experiment period (see Table 2). (3) Adrenalectomized rats do not respond to insulin with increased appetite, but nevertheless show clear-cut deposition of glycogen in their adipose tissue following insulin injection. The same experiments and others with adrenalin show, furthermore, that glycogen deposition in the adipose tissue cannot be due to increase in blood adrenalin as a result of insulin administration.

TABLE 2.

	No. of expts.	Glycogen gm./100 gm. adipose tissue			Blood sugar
		Total fat	Mesent. fat	Inter-scap. fat	
Diet: 70% casein; after 20 hr. fasting $2 \times 0{\cdot}3$ U.Pr.Z.Ins.; 5 hr. later sacrificed	5	0	0	0·30	47
Adrenalect. rats; drink: 25% glucose in Rubin-Krick sol. during 30 hr.; in the evening and in the morning —1 U.Pr.Z.Ins.; sacrificed 6 hr. after morning injection	10	0·26	0·46	0·16	63
Controls without insulin	7	0	0	0·03	104

It follows that the effect of insulin is direct on the adipose tissue; and almost certainly that glycogen deposition in the adipose tissue is a preliminary of a larger process which the adipose tissue realizes. A new proof is thus obtained for the view that adipose tissue plays an active part in carbohydrate-fat metabolism.

The bearing of these findings on the theory of insulin action remains to be considered.

(1) The insulin influence on adipose tissue constitutes clear evidence that insulin is concerned in glycogen synthesis. In absence of insulin, adipose tissue normally is void of glycogen.

(2) With reference to the question whether storage of glycogen in adipose tissue has significant bearing on the carbohydrate balance during the period of reaction to insulin, it may be pointed out that the amounts of glycogen actually found in the adipose are in themselves insufficient to be of great significance in relation to the total carbohydrate balance. It should be borne in mind, however, that the found adipose glycogen is in fact a resultant of concurrent processes of synthesis and decomposition. It is certain only that glycogen is being transformed. The finding of glycogen is thus in itself merely evidence of the existence of the adipose-insulin relation. Earlier investigations and the fact that insulin administration leads to fat deposition support the assumption that glycogen is converted in adipose tissue into fat. We believe, therefore, that the primary effect of insulin on adipose tissue is to induce glycogen deposition, and assume that deposed glycogen is then automatically converted by the tissue into fat. Thus we arrive at a factor in insulin action similar to that convincingly educed on quite different grounds by Pauls and Drury[6]: a transient storage of ingested carbohydrate as fat. Insulin may be regarded as an accelerant of this process by virtue of its effect on adipose synthesis of glycogen.

Details of this investigation will be published elsewhere.

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Aug. 11.

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Newt Larvæ in Brackish Water

MR. ERIC HARDY, in referring[1] to Miss Helen Spurway's observation of newt larvæ in brackish water[2], states that "the brackish 'slacks' or pools between the west Lancashire coastal dunes from Ainsdale to Formby have long been inhabited by breeding specimens of the common smooth newt, common frog, common toad and natterjack toad". C. T. Green, in his Flora[3], states that "both salt and freshwater plants live in separate, though adjoining areas. The salt and the fresh water here have been readily distinguished by taking their specific gravity".

It occurred to us to test the accuracy of the term 'brackish' as applied to-day to the permanent water on the Freshfield to Ainsdale dunes, and samples were taken this summer from long-standing and well-known slacks and pools and analysed for chloride content, with the following results:

June 1943	Bullrush slack	10·9 parts of sodium chloride per 100,000.
	Drainage pool on an inland slack	8·4 parts of sodium chloride per 100,000.
July 1943	Bullrush slack	10·7 parts of sodium chloride per 100,000.
August 1943	Drainage pool on an inland slack	8·0 parts of sodium chloride per 100,000.

The water samples showed 27–29 parts of calcium carbonate per 100,000 with 21·5–24·5 parts of calcium carbonate per 100,000 as temporary hardness. Hardness due to magnesium salts was very slight. The *p*H values varied from 7·6 to 8·0.

It would thus appear that much, if not most, of the water on the West Lancashire dunes is not 'brackish' at the present time, though doubtless there have been times when localities between Ainsdale and Hightown have had a more brackish character; but records of past years should not be applied indiscriminately to the present.

It may be of interest to note that one of us (F. B.) observed on May 2, 1943, in the saline waters near Nantwich Salt Spring, amphibian larvæ of large size, living in a salinity of 312·3 parts of sodium chloride per 100,000.

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Slip and Twinning in Single Crystals of Mercury

IN 1935 Prof. E. N. da C. Andrade and Mr. P. J. Hutchings described[1] the results of interesting experiments on the deformation of single crystals of mercury, and it is concluded that in a mercury crystal the rhombohedral faces are the glide planes—as (it was stated) would be expected from the fact that these are the planes of closest packing. Of many measurements that had been made of the intersection angles between glide and twinning plane traces, three sets in particular were considered to furnish strong confirmation of the above conclusion.

I have recently had occasion to examine this analysis, and, as a result, would make the following observations:

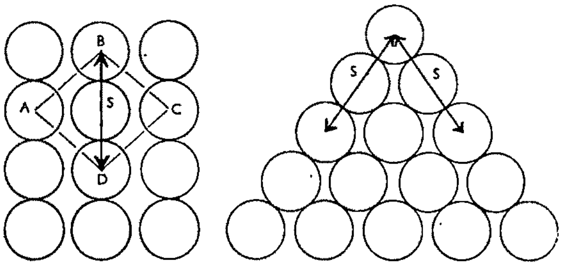
Not the rhombohedral faces {100} but the pyramidal planes $\{11\bar{1}\}$ are those most closely packed in the mercury crystal lattice. This is readily seen on laying out the atomic positions, as in the accompanying diagram, in which the {100} packing is shown at (*a*) and the $\{11\bar{1}\}$ packing at (*b*). It will be seen that while the {100} planes contain one line of close packing—the short diagonal of a rhomb face—the three $\{11\bar{1}\}$ planes each contain the two short diagonals of adjacent rhomb faces, and therefore must be more closely packed than the {100} planes.

This fact necessitates a reconsideration of the main conclusion of Andrade and Hutchings' analysis—that the rhomb faces are the glide planes. The position is, that if the {100} planes are the glide planes, as appeared to be indicated by the recorded angular measurements, which fulfil the geometrical requirements, then glide in mercury crystals does not follow the general rule for face-centred metals, namely, that it takes place on the most densely packed plane.

On the other hand, if glide actually does take place on the most densely packed plane (shown above to be $\{11\bar{1}\}$), then the measurements recorded as satisfying {100} glide must correspond also with the geometrical requirements for the $\{11\bar{1}\}$ mode of glide, which will be a curious coincidence.

Calculation shows that this coincidence actually exists, thus: (1) Double glide was observed on surfaces symmetrically disposed in relation to an axis of the mercury wire examined. The angle between the two planes was 74·4° which, corrected for elongation, gave 78·8° as the original dihedral angle. It was pointed out that the smaller dihedral angle between rhomb faces is 80·3°, and this close correspondence was adduced as evidence for glide on rhomb faces. Calculation shows, however, that the dihedral angle between two $\{11\bar{1}\}$ planes is 75·5°, so that this particular observation may well be considered as evidence for glide on $\{11\bar{1}\}$ planes. Andrade and Hutchings reported having measured several cases of double glide, in every case finding the corrected included angle to be slightly less than 80·3°.

(2) Several measurements were taken of the angle between the slip lines and the twinning plane {110}. The measured angles varied between 75° and 77·5°. The calculated angle being 77·4°, the correspondence was held as additional confirmation of {100} glide. However, calculation shows that the angle between the {110} (twinning plane) and either of two $\{11\bar{1}\}$ pyramidal planes is 82·3°, which appears to be sufficiently near the observed angles to be considered as evidence for $\{11\bar{1}\}$ glide. The crystal in which the value of 75° was obtained was stated by Andrade and Hutchings to be not very favourable for measurement.



{100} packing {11$\bar{1}$} packing

COMPARISON OF ATOMIC PACKING ON DIFFERENT PLANES OF SINGLE MERCURY CRYSTAL.

(3) The third set of measurements were those made on a wire extended to rupture. Traces of glide on the surface of rupture were observed to make an angle of almost 50° with a line of commencing rupture parallel to the long diagonal of a rhomb face, and this is stated to agree with the value of 49·1° to be expected if the glide direction is a short diagonal of the rhomb face. Calculation shows that traces of {100} planes on the adjacent rhomb faces make an angle of 40·9°, with lines parallel to the long diagonal. This is 9° different from the observed angle. If the line of commencing rupture seen was unmistakably parallel to the long diagonal, traces of a $\{11\bar{1}\}$ plane on a twinning plane {110} could make with that line an angle of 52·9°, which may be considered sufficiently near 50° (observed) to be held as confirmation of $\{11\bar{1}\}$ glide. This then requires (*a*) the observed surface of fracture to be a twinning plane in order to explain the existence of the long diagonal as a commencing line of rupture, and (*b*), the final fracture by direct separation. It is suggested this is a probable mode of fracture at the part of the crystal concerned.

With regard to the glide direction, the evidence remains in favour of this being the short diagonal of the rhomb face, while in regard to the twinning plane, no contradiction is involved in accepting the evidence for {110}.

Summing up, it would appear that: (*a*) the $\{11\bar{1}\}$ planes are those most closely packed; (*b*) glide takes place on these planes; (*c*) the direction of glide is the short diagonal of the rhomb face; (*d*) there are two such glide directions in each glide plane.

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[1] Andrade, E. N. da C., and Hutchings, P. J., *Proc. Roy. Soc.*, A, 148, 120 (1935).

MR. FISHER is, I expect, right when he points out that the $\{11\bar{1}\}$ planes are the most closely packed in a mercury single crystal, although I have not the time to check the work. The experiments to which he refers were carried out some years ago, and all notes referring to them were destroyed with my laboratory. Whether he is right in his surmise that the $\{11\bar{1}\}$ planes may be the glide planes I cannot say. The only way of settling the question satisfactorily is by the X-ray method. I always intended to get the attribution checked in this way, but at the time when the work was done an X-ray set suitable for this purpose had not been installed, as it was later. We were discussing the X-ray determination in my laboratory shortly before the War broke out.

It is not, of course, necessary that the most closely packed planes should be the glide planes in all cases, although the most closely packed direction is always the glide direction. This emerges very clearly from some work which I carried out with Dr. Y. S. Chow[1] on body-centred cubic crystals. The matter of the glide plane must, therefore, remain open until I, or someone else, put it to the X-ray test.

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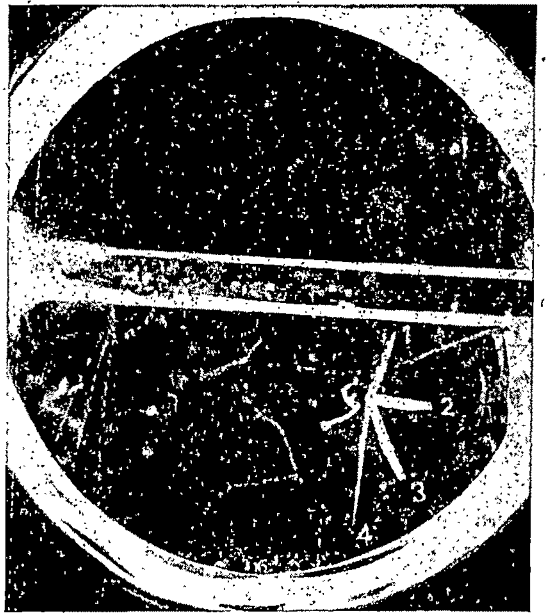
Photograph of a Nuclear Disintegration in a Wilson Chamber

THE presence of heavy ionization tracks has often been observed in Wilson chamber photographs; those due to the emission of α-particles from radioactive impurities can be easily eliminated. The rest are due to nuclear disintegrations produced by cosmic rays. Usually they emerge from lead plates placed inside such chambers. Photographs of disintegrations originating in the gaseous volume of a Wilson chamber are rare; so far as is known to us, Anderson and Neddermeyer[1] have photographed one, and Zlotowsky[2] another. The particles are supposed to be produced by a nuclear evaporation process leading to the emission of both protons and neutrons; in some cases α-particles have also been detected amongst them.

The accompanying photograph shows the emission of four ionizing particles from a nucleus in the gaseous volume of a Wilson chamber filled with oxygen. From the density of ionization along their tracks, the particles appear to be heavier than α-particles and are multiple-charged. As in Anderson's photograph[1], the emitted particles are confined within a hemisphere, and conservation of momentum requires that either a number of neutrons have been emitted in the opposite direction or that a fast non-ionizing particle is responsible for the disintegration—the latter assumption appears more reasonable. A faint mesotron track is seen to cross the lead plate (2·2 cm. thick) and follow the continuation of track 4; it cannot be taken to be responsible for the process of disintegration, as the track in question does not show any scattering or change in ionization density after passing the point of origin of the disintegrated nucleus. Tracks 1 and 4 are of a similar nature; both show jagged outlines, due to ionization by recoil ions produced by nuclear collisions with the primary charged particles; the ionization density along the track of the particle diminishes. Such ionization tracks are to be expected of slow multiple-charged heavy particles, the effective charge of which diminishes with velocity, due to successive neutralizations. Such tracks have been observed in Wilson chamber photographs of fission of the uranium nucleus[3].



THE RANGES OF TRACKS 1, 2, 3 AND 4 CONVERTED TO NORMAL PRESSURES ARE 5·33, 4·76, 6·56 AND 9·01 CM. RESPECTIVELY.

Tracks 2 and 3 are broad and of uniform width throughout their whole lengths, except near the very end where there is a sharp fall of ionization—due to partial neutralization of charges on the ionizing particles. These tracks are similar to those due to α-particles except they are broader; they may be due to doubly-charged heavy particles. The end portions of their tracks are crossed transversely by thin ionization tracks. An obvious explanation of the observed effect is that, due to pure chance, the heavy-particle tracks are crossed at corresponding end points by two electron tracks. But the simultaneous occurrence of such events must be extremely rare. An alternative explanation, which appears to us plausible, is that each of the particles producing the tracks 2 and 3 emits, after it has slowed down, a pair of ionizing particles. In the original photograph, the track crossing the end portion of 3 is slightly bent towards the latter, showing that the particles emitted had a velocity component in the direction of motion of the parent particle. If this explanation is accepted, we have further to account for the fact that the pair of particles are emitted in diametrically opposite directions. This can be accounted for on the assumption that the original nucleus disintegrates into two simpler nuclei which move in opposite directions. Among the lighter nuclei, it is known that ^{8}B produced by the interaction ^{7}Li+^{1}H disintegrates with the emission of a pair of α-particles, the Wilson chamber photographs of which have been obtained by Dee and Walton[4]. The tracks of the pair emitted from the ends of tracks 2 and 3 appear to be too thin to be due to α-particles.

The other alternative is that a pair of (oppositely charged) electrons were emitted from the nuclei of the primary particles. I am not aware that emission of a pair of electrons from an excited nucleus in diametrically opposite directions has been previously observed, and there may be some theoretical difficulty in accounting for such an occurrence.

The interpretation of the origin of the tracks in the photograph given in this communication has arisen out of a discussion with Prof. D. M. Bose, to whom my thanks are due.

M. SINHA.

Bose Institute,
Calcutta. July 1.

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[2] Zlotowsky, NATURE, **140**, 585 (1937).

[3] Brostrom, Boggild, Lauritsen, *Phys. Rev.*, **58**, 651 (1940), *et seq.*

[4] Dee and Walton, *Proc. Roy. Soc.*, **141**, 733 (1933).

Cacao Tannin

THE method most commonly used for the estimation of cacao tannin is by precipitation with cinchonine sulphate[1,2,3]. Duthie[4] found that the filtrate from the cinchonine tannate gave a precipitate on refluxing with formaldehyde and hydrochloric acid (Stiasny reagent). He suggested that this precipitate is a measure of catechin and similar phenolic compounds.

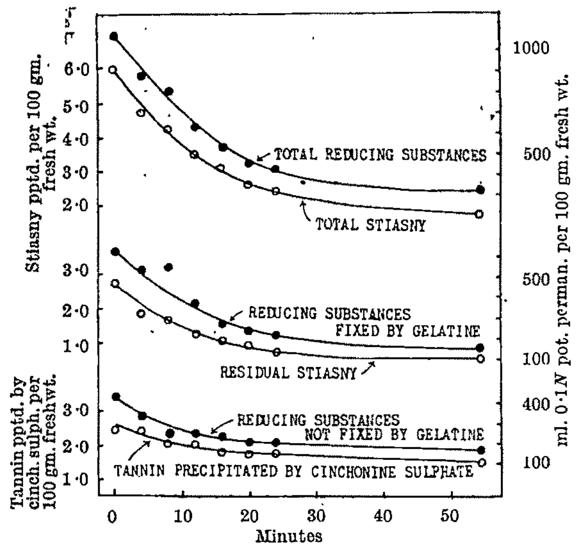
During some experiments in which freshly picked cacao beans were minced and allowed to autolyse, it was found that the amount of tannin, extracted with 40 per cent acetone and precipitated by cinchonine sulphate, decreased progressively with time and that the Stiasny precipitate of the filtrate (residual Stiasny precipitate) decreased proportionally. A Stiasny determination (total Stiasny precipitate) on an aliquot of the original tannin solution yielded a precipitate which was approximately equal to the sum of the cinchonine tannin and the residual Stiasny precipitate (cf. Duthie[4]). These results suggest that the cinchonine sulphate acts selectively on the tannin molecule and combines with a part of it, or that two substances are present, one yielding a precipitate with cinchonine sulphate and the other a Stiasny precipitate, and both substances decrease proportionally with time. The latter explanation seems less likely.

Tannin determinations were also made by a Lowenthal procedure[5]. The amount of tannin estimated by this method (that is, reducing substances fixed by gelatine) was found to run parallel to the residual Stiasny determinations, while the amount of the total substances oxidizable by potassium permanganate closely followed the changes in the amount of total Stiasny precipitate, and the amount of reducing substances not fixed by gelatine followed the changes in amount of tannin precipitated by cinchonine sulphate. It thus appears that in the case of cacao, the cinchonine sulphate reacts with one part of the tannin molecule while gelatine reacts with the other part.

Evidence in support of the above explanation was obtained by making Stiasny determinations on the filtrate from solutions of cacao tannin treated with gelatine and sodium chloride. The values obtained corresponded to the amount of tannin precipitated by cinchonine sulphate from the original solutions.

In this connexion it may be recalled that Smith[6], working with tea infusions, found that the filtrate from the cinchonine tannate gave a colour and precipitate on addition of ferric salts but he was unable to identify the substance responsible. Chapman[7] reported that in the case of hops, the cinchonine tannate filtrate gave a colour with ferric chloride.

Hitherto the results obtained from the two methods of determining tannins have shown little agreement and the above observations offer an explanation and appear to throw fresh light on the structure of the cacao tannin molecule. The cinchonine sulphate and Lowenthal methods may be brought into agreement, so far as cacao is concerned, by taking into account the total Stiasny precipitate, the residual Stiasny precipitate and the cinchonine sulphate precipitate in the one method, and the total reducing substances, reducing substances fixed by gelatine and the reducing substances not fixed by gelatine, in the other method. Certain non-tannin materials which are oxidized by permanganate are present in the cacao bean, but these are very small in amount compared with the amount of tannin. These methods may be applicable to tannin determinations in other plant material if the amount of non-tannin reducing material is known.



E. C. HUMPHRIES.

Imperial College of Tropical Agriculture,
Trinidad, B.W.I.
Sept. 22.

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A Transverse Zoo-geographical Barrier on the East Side of Lake Tanganyika

No outstanding discontinuity of animal distribution as one proceeds from north to south down the east side of Lake Tanganyika would be inferred from most maps of the region. It is obvious only that along much of the Lake shores the land rises to above 5,000 ft., which has been generally accepted as the approximate lower level of the Highland life-zone in Central Africa. The latest maps[1], which are a great advance on their predecessors, show plainly that on the east side of the Lake the highland country falls into three parts: (*a*) the narrow strip north of Kigoma, which, through Urundi, is continuous with the Kivu and Mufumbiro mountain area, and on the south is separated by the depression centring round the Malagarasi River from (*b*) the much-dissected Kungwe, Mahari, Baholoholo high country, separated on the south by the low gap round Karema from (*c*) the Ufipa Plateau, which is continuous with the highlands on the Northern Rhodesian border and round the head of Lake Nyasa.

A study of the 1/1 mill. map[1] shows that in width the Malagarasi Depression and the Karema Gap are similar, the distance in both between any considerable areas over 5,000 ft. being about eighty miles, but the Karema gap has the flatter bottom, with more of it below 4,000 ft. Looking from the shore of Lake Tanganyika, one gains a strong impression of the Karema gap as a corridor running eastwards, towards the northern end of the Rukwa trough, while the Malagarasi depression is conspicuously hilly.

No vegetation maps of the region in any greater detail than that of Engler[2] exist, and that errs in giving the *Hochweide* too great and continuous a range, right across the Karema gap; but for the present purpose the important point is that evergreen forest remains practically only in small patches in the three highland areas. 'Miombo' (Brachystegia—Isoberlinia) deciduous woodland or, in Ufipa, open grassland, predominates all down the east side of Lake Tanganyika.

From the foregoing it might be expected that the mountain and forest fauna of the Kungwe highland would show northern and southern affinities in roughly equal proportions, with a slight preponderance of the former due to the better 'stepping stones' available across the Malagarasi depression than across the Karema gap. Recent collections of birds made on Kungwe and in Ufipa for the British Museum show that the avifaunal composition on Kungwe differs greatly from expectation, as follows[3]: (1) Total number of species: Kungwe 41, Ufipa 29. (2) Number of 'widespread' species, that is, occurring both farther north and farther south than Lake Tanganyika: Kungwe 16 (39 per cent), Ufipa 17 (58 per cent). (3) Number of purely 'northern' species: Kungwe 21 (51 per cent), Ufipa 3 (10 per cent). (4) Number of purely 'southern' species: Kungwe 2 (5 per cent), Ufipa 9 (31 per cent).

The remaining two species on Kungwe are regarded as endemics; the two 'southern' species on Kungwe are both very strongly marked sub-species, while of the three 'northern' species that reach Ufipa two are subspecifically distinct.

In conjunction with the foregoing evidence we have the fact that the chimpanzee extends south so far as the south edge of the Kungwe highland (latitude 6° 30′ S.), but there is no indication of the animal in Ufipa. The conclusion is that the Karema gap is of much greater zoo-geographical significance than the Malagarasi depression. I am indebted to Mr. Clement Gillman for a discussion of the local geology and for references. Certain of these[4,5,6,7] show an increasing tendency to regard the Karema gap as representing an ancient south-east – north-west rift, which reappears west of Lake Tanganyika in the Lukuga depression at Albertville. This rift was probably earlier than the Rukwa – Nyasa trough and certainly much earlier than the Pleistocene rift now occupied by Lake Tanganyika. Moreover, the efficiency of the Karema gap as a barrier to animals would have been increased by the water connexion that it appears to have provided between Lakes Tanganyika and Rukwa in geologically recent times[8].

In this instance faunistic and admittedly as yet tentative geological evidence give each other powerful support.

R. E. MOREAU.

East African Agricultural Research Station,
Amani.
Nov. 6.

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Relation between Dissonance and Context

THE effect of musical context on dissonance, di cussed by Gardner and Pickford in NATURE (September 25, is so much a part of the musician everyday experience that he will probably regar an experimental programme to establish the existenc of this effect as entirely redundant.

A simple illustration of the bearing of context o dissonance may be obtained on a pianoforte by pla ing middle *C* together with its seventh (*B* natura and octave. As an isolated sound this is unpleasan Now play the scale of *C* major introducing the ke note and octave each time. This time the effect c the penultimate dissonance is entirely differen although it is precisely the same combination a before. It now takes its place in a regular progression towards the keynote, and when the sevent is introduced the anticipation of the approachin resolution into the major chord is intensely stimulating.

Herein lies the secret of the effect. If the dissonanc is introduced in such a way that the trained ear ca anticipate its resolution by regular progression, the that anticipation gives rise to pleasure which s heavily outweighs the jarring of the isolated soun that this jarring escapes notice and the net effect i one of satisfaction.

I recently ventured to criticize a discord in a com position which one of my friends had just com pleted, and was met by the argument that "Chopi used that discord a great deal". So he did—bu always in a way which gave rise to the pleasurabl anticipation of its resolution.

C. G. GRAY.

IN his interesting letter Mr. Gray has put forwar the theory that dissonances, which he assumes to b constant in harshness whatever their contexts, ma be masked or softened by the pleasure of the music experience of their anticipated resolution, whe heard by a man whose training enables him to mak that anticipation.

Gardner and Pickford, in their letter in NATUR of September 25, explained that the question c pleasure, or rather of liking and disliking, was avoide so far as possible in their experiment. They wer concerned with the more subtle, though no les interesting question, whether the dissonance level o a chord might itself be subject to variation owin to the context, and apart from special musical training. In other words, they raised the question whethe dissonance itself, which is an experience, not a object, may be relative, not the question whethe pleasure may mask it.

The resort to experimental research certainly doe not in any way supersede or render useless exper observations of the kind Mr. Gray is able to mak but it allows us to focus attention upon special point effectively and gives us the opportunity of utilizin carefully balanced evidence. It would be valuabl if Mr. Gray could construct a series of examples o varying complexity which illustrate his theme an which could be used in a short experiment.

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VALUE OF HORSE CHESTNUTS AS FOOD FOR PIGS

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IN time of war the utilization of wild seeds as animal feeding stuffs attracts much attention. Primary consideration is usually given to acorns[1] and horse chestnuts[2], owing to their size and to the quantity in which they could be made available, should their value justify an organized collection.

The chemical composition of horse chestnuts and the figures for digestibility of their components[3] suggest that they should prove a valuable carbohydrate food for livestock. On the other hand, the rather high content of tannic acid (more than 0·25 per cent) which gives them a bitter taste, and the presence of injurious substances like the nitrogen-free glucosides, saponin and esculin, would appear seriously to limit their value as a feeding-stuff.

The evidence available in the literature indicates that the value of horse chestnuts as food for live stock is in fact limited[2], but many of the data are not definite, and sometimes contradictory.

An experiment designed to gain additional information on the value of horse chestnuts as a feeding stuff for pigs seemed worth while, and the following is a brief report on the work carried out in the autumn and winter of 1942–43.

The horse chestnuts used were collected in the neighbourhood of the Institute by local schoolchildren. When given raw the horse chestnuts were not eaten by the pigs, either in their original state or after being crushed. When given to the pigs mixed with meal they were consistently refused, while the meal was completely eaten. Not even by cutting down considerably the meal allowance was it possible to persuade the pigs to eat the chestnuts. Whether this was due to the bitter taste of the nut, or to the reluctance of the animal to take toxic substances, has not been investigated. An experiment was planned to find out whether by preparation the horse chestnuts could be made more palatable to the pigs, and if so, whether their feeding value justifies the trouble and expense connected with the preparation.

Horse chestnuts prepared in three different ways were used: (*a*) dried and ground to a meal, (*b*) boiled, and (*c*) soaked in cold water.

The drying of the horse chestnuts was carried out in a hot-air drier, through which air, at about 140° F., was blown by means of an electric fan. It was found that by crushing the chestnuts before drying the time of the operation could be reduced 4–5 times. After crushing, the drying was completed in 26–28 hours. The dried chestnuts were ground to a meal, the chemical composition of which was as follows: moisture 11·1 per cent, crude protein 6·6 per cent, oil 5·7 per cent, carbohydrates 70·0 per cent, crude fibre 4·3 per cent and ash 2·3 per cent. The boiling of the chestnuts was done every three days throughout the experimental period. The chestnuts were crushed and were boiled for one hour with an equal weight of water. When the boiling was completed the water, then a yellow-grey liquid, was drained off, leaving the nuts soft, but the shell remained hard. Boiled chestnuts kept well for about a week, after which mould developed.

The third treatment consisted of soaking crushed chestnuts in cold water for at least forty-eight hours before feeding. After that time the smell suggested that some fermentation had taken place. The yellow-greenish liquid was drained off. The soaked chestnuts did not keep well, mould starting after less than two days. On the other hand, when after draining off the liquid, clean water was added, the chestnuts kept in good condition for at least one week. It is of interest to note that soaking of whole, uncrushed chestnuts for a week in cold water did not seem to have any effect on them.

As the time progressed the horse chestnuts, which were stored spread on a concrete floor in the piggery, deteriorated fairly rapidly. Towards the end of the experiment more than half the nuts had to be rejected at crushing. Evidently, unless dried by artificial means the chestnuts will not keep for any considerable time.

Soon after the commencement of the experiment it was found that the shell of the chestnuts is unpalatable to the animals, and that they refused to eat it. After a fortnight it was decided to feed both the boiled and the soaked chestnuts without the shell, and the nuts were decorticated before feeding. The shells were removed by hand, a rather tedious and time-consuming operation.

Experimental.—The method of individual feeding was adopted. Five treatments were introduced, and five pigs, one allocated to each of the treatments, formed an experimental block. Three blocks were operated, that is, each treatment was replicated three times. All the five pigs constituting a block were litter-mates and as alike as possible at the beginning of the experiment. The pigs used were home-bred Large White, and were put on the experiment when about fourteen weeks old.

The five experimental treatments were as follows: (1) Control—normal fattening diet. (2) Negative control, similar to diet 1, except that 10 per cent of the wheat feed was left out from the mixture, and the pigs were fed to a scale reduced by 10 per cent. (3) As diet 1, but with 10 per cent of the wheat feed replaced by dried horse chestnut meal. (4) As diet 1, but with 10 per cent of the wheat feed replaced by boiled horse chestnuts (decorticated). (5) As diet 1, but with 10 per cent of the wheat feed replaced by decorticated horse chestnuts soaked in cold water for at least forty-eight hours before feeding.

The composition of the control diet (1) was as follows (all parts by weight): wheat feed 40, barley meal 28, ground oats 20, fish meal 10, dried grass 2. The meal mixtures were all mixed by hand in the piggery.

The animals were rationed according to a scale for fattening pigs recommended by the Pigs Experiments Coordination Committee[4], except for the pigs on treatment 2, which were fed at a level lower by 10 per cent. The meal was weighed out and fed twice daily in the form of a wet mash, 3 lb. of water being allowed for each pound of meal. The boiled and soaked chestnuts were added directly to the troughs and were well mixed with the meal. The chestnut meal formed a constituent of the meal mixture fed to pigs on treatment 3.

The experiment commenced on December 17, 1942, and was continued for 133 days (nineteen weeks).

Results and discussion.—The results of the feeding trial are summarized in the accompanying table.

The small number of animals used in this test does not allow final conclusions to be drawn, but the following observations may be made.

	Treatment				
	1	2	3	4	5
Average initial live weight	70·3	68·0	70·7	68·0	75·0
Average live weight gain	149·0	141·3	125·7	138·0	147·3
Average daily live weight gain	1·12	1·06	0·95	1·04	1·11
Pounds of food per one pound live weight gain	4·0	3·7	4·6	4·0	4·1

When horse chestnuts, either in dried form, or boiled, or soaked, are added to a fattening mixture at a rate of 10 per cent of the ration, the pigs consume them, and no toxic effects are observed. The food value, of such chestnuts is, however, very small, and it appears that the low nutritive value is mainly connected with the unpalatable, thick, hard shell which the pigs tend to reject provided they could separate it from the rest of the meal. When the shell is removed, the decorticated soaked chestnuts are able to replace satisfactorily 10 per cent of wheat feed in a balanced fattening meal. Boiling the chestnuts before feeding reduces their nutritive value, some of the nutrients being dissolved and drained off with the liquid. Even after boiling the shell remains objectionable to the animals.

Although, as we have found in a post-experimental period, the amount of decorticated and prepared chestnuts can be increased to about 20 per cent of the ration, none of the methods of preparation merits recommendation for practical application. The difficulties in storing raw chestnuts and the labour and cost of preparation prohibit the feeding of chestnuts to pigs.

The dried horse chestnut meal has no nutritive value, and the animals show a definite dislike to the meal mixture containing it. Whatever the nutritive value of the nut itself, the presence in the meal of the ground shell completely hides it. The question of the nutritive value of decorticated, but otherwise untreated, horse chestnut meal remains open.

[1] Braude, R., and Foot, A. S., *J. Min. Agric.* (August 1943).

[2] NATURE, **152**, 345 (1943).

[3] Ministry of Agriculture Bull. No. 124.

[4] Quoted by Braude and Foot, *J. Agric. Sci.*, **32**, 73, Table 2.

CONSERVATION OF HUMUS IN TROPICAL SOILS

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THE part played by humic manures in soil processes and in plant nutrition, both as a source of mineral elements and by improving the physical condition of the soil, is well known. The advantages of properly devised rotational systems of cropping in soil husbandry are also established by both practice and experience. It is therefore reasonable to expect results of great economic importance by a combination of rotational cropping with humic manuring. The permanent manurial small plots at the Institute of Plant Industry, Indore, afforded an opportunity of studying the relative importance of humic manures and crop rotation on the conservation of soil properties. These plots, sixteen in number, have, since 1933, been receiving annual surface dressings of farm compost, farmyard manure and municipal compost, all at ten tons per acre, and have been under a four-year rotational cropping with (i) cotton, (ii) sann (*Crotalaria juncea*), ploughed in and followed by wheat, (iii) ground nut, and (iv) jowar (*Andropogon sorghum*); one set of four plots (including a control unmanured plot) being under a particular crop during a season. The plots treated with the different humic manures, while yielding more or less alike from year to year with all the crops, had frequently given more than double the yields of the untreated plots.

Surface (0–6 in.) and subsoil (6–12 in.) samples were taken from each of these plots during flowering time in October and examined individually in the laboratory. Some of the results obtained are discussed here. Only the average values for corresponding plots are given in Table 1, there being no appreciable difference in the results for plots under different crops.

It will be observed that the surface layers of the manured plots contain a lower percentage of clay and fine silt as compared to the untreated plots. This is no doubt due to the greater infiltration, on account of openness of soil, in these cases. It is well recognized that cultivation or addition of organic matter increases pore space and decreases volume-weight, and that these are followed by increased infiltration capacity. From the data, however, it is seen that the differences in pore space or volume-weight between the untreated and manured plots are only small. Likewise, the values for moisture-holding capacity are about the same for all the soils, thus suggesting that, with crop rotation, even unmanured plots do not deteriorate in physical properties. It should be remembered that these plots receive a green manure of sann once during every complete rotation of four years and that, besides, another legume is included in the rotation.

The most significant contrast between the unmanured and treated plots, accounting for the difference in their productivity, is revealed, however, from an examination of the values for carbon and nitrogen which shows that the latter contain much higher percentages of nitrogen and, especially, of carbon. This enrichment of organic matter is also reflected in the higher structural coefficients of these plots[1].

That the building up of the soil organic matter through humic manures has steadily increased with time can be seen from Table 2, which gives the percentage increases, over untreated plots, in carbon and nitrogen at different periods for all the humic manured plots (averages).

The high values obtained for carbon and nitrogen during July is obviously due to the plots having received the manures during the preceding month.

Exposure of humus-rich soil, sampled in February 1943, for nearly six months, which included the hot summer months of April–June, had resulted only in a loss of 4·2 and 10·1 per cent of carbon from the surface and subsoil samples respectively, the corresponding losses from the untreated plots being 7·9 and 5·1 per cent; but during this period there was considerable fixation of atmospheric nitrogen with both soils. Further work is in progress to study the influence of different environmental factors on the carbon and nitrogen status of these soils.

The conservation of carbon and nitrogen through humic manuring is by no means unfamiliar in temperate regions. Thus, from a study of the changes in soil composition caused by fertilizer treatments in the Broadbalk manurial plots at Rothamsted, it is recorded that on the farmyard manure treated plot

TABLE 1. INFLUENCE OF MANURING AND CROP ROTATION ON SOIL PROPERTIES.

Treatment	Depth (in.)	Clay + fine silt (per cent)*	Pore space (c.c. per 100 c.c.)†	Volume-weight (gm. per 100 c.c.)†	Moisture content of saturated soil (per cent)†	Coefficient of structure	Carbon (per cent)*	Nitrogen (per cent)*
Farm compost	0–6	45·6	57·3	140	56·8	0·66	0·89	0·151
	6–12	47·1	59·1	142	58·5	0·69	0·72	0·139
Farmyard manure	0–6	46·6	57·0	142	57·2	0·69	0·84	0·140
	6–12	49·8	55·7	140	58·0	0·70	0·70	0·132
Municipal compost	0–6	48·4	55·9	142	57·3	0·68	0·78	0·130
	6–12	47·6	57·0	140	57·2	0·70	0·72	0·129
Untreated control	0–6	50·0	56·4	143	55·5	0·60	0·59	0·118
	6–12	48·6	57·8	145	56·1	0·60	0·60	0·113

* On oven-dry basis. † On air-dry basis.

there has been a marked gain in both carbon and nitrogen, especially in the earlier years, the soil now containing more than twice as much organic matter as most of the other plots[2]. Similar results on the increase in nitrogen content of farmyard manure plots cropped continuously with wheat and barley have been observed at Woburn[3]. An improvement in the nitrogen status of soils following the addition of farmyard manure to soil even under tropical conditions has recently been shown by Dhar and Mukerji[4]; according to these authors, the carbonaceous substances from the decomposition of organic manures assist in the fixation and conservation of soil nitrogen[5].

On the other hand, it has been frequently contended that every soil, depending on a number of complex and interlocked factors, mostly climatic, has more or less definite organic matter and nitrogen status and that it is, therefore, scarcely worth while to attempt to maintain the soil nitrogen and organic matter above certain percentages[6–9]. The foregoing observations would suggest, however, that by the application of bulky organic manures these constituents can, within limits, be maintained at higher levels and within an expense that may be justifiable in terms of crop rotation. In analysing the results of fifty years of field experiments at the Woburn Experimental Station, Russell and Voelcker have recently come to the conclusion that soil impoverishment under continuous cropping can best be prevented by a combination of farmyard manure with crop rotation[3].

Humic manures are generally slow-acting and have, in consequence, a much higher residual effect as compared with the immediately available commercial fertilizers. With a deep-rooted crop such as cotton, therefore, their application may not be advisable if their full value is to be utilized. But if they are applied to a previous surface-rooted crop in the rotation they will not only benefit that crop but also have their characteristic effect on the deeper soil layers by the time the turn of the cotton crop comes. This fact has been fully borne out by the work at Indore, where (i) successive application of compost has given consistently high yields with cotton over a period of years, and (ii) in rotation experiments, compost application to the previous crop has always benefited the succeeding cotton crop.

TABLE 2. PERCENTAGE INCREASE IN CARBON AND NITROGEN OVER UNMANURED PLOTS.

Period of sampling	Carbon		Nitrogen	
	Surface soil	Subsoil	Surface soil	Subsoil
October 1940	42·4	18·3	18·6	17·7
July 1942	64·1	33·3	69·6	43·5
February 1943	50·8	33·9	35·4	19·6

Agronomic practice hitherto has largely been directed towards determining what manures should be applied to each particular crop. The experience with the permanent manurial plots, however, suggests that it would be more beneficial to manure with the object solely of building up the general fertility of the soil, so as to take care of all crops in the rotation and thus conserve the natural resources of the soil and, in some measure, even improve on them.

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RELATION BETWEEN BODY-SIZE, WAKING ACTIVITY, SIZE OF EYE-BALLS, AND THE ORIGIN OF SOCIAL LIFE IN THE PRIMATES

By PROF. M. F. ASHLEY MONTAGU

Hahnemann Medical College and Hospital, Philadelphia

THE demonstration of significant, that is to say functional, interrelations between characters of size, morphology, physiology, and social behaviour has not, to my knowledge, hitherto been made for any group of the order of Primates, including man. In the present communication I should like to report what seems to be the invariable association of four such distinctive characters which are operative throughout the order.

Commencing with an examination of the most primitive members of the order of Primates, the lemurs, we find that they fall into two groups; one is practically completely nocturnal in its habits, sleeping by day and spending most of its waking hours during the night, while the other is mainly diurnal, being almost entirely active by day alone. Like most Primates, all lemurs are arboreal creatures, though the larger lemurs, particularly of the genus Lemur, spend a good deal of time among the rocks. Now, it is a striking fact that the lemurs of small body-size are all, unexceptionally, the most definitely nocturnal in their habits, while those of larger size are almost entirely diurnal. This in itself is an interesting association. It would also appear that the small nocturnal lemurs have larger eyeballs than the larger diurnal lemurs. Finally, the small nocturnal lemurs live either in pairs or in single families, while the larger diurnal lemurs tend to live in small groups which contain the members of at least one other family.

Since the lemurs represent the most primitive, as well as the oldest, type of Primates, being, indeed, best regarded as a relict group, it may reasonably be assumed that they preserve the social habits of even earlier ancestral Primates. The point is not very important, but it is worth mention because it is known that the earliest Primates were not much larger than small rats, and from this—together with the evidence cited in this communication—it may be inferred that they were probably nocturnal in their habits, and lived in pairs or single families, as do the closely related primatoid menotyphlous insectivores (for example, Tupaiidæ) to this day.

The evidence provided by the lemurs suggests that small arboreal Primates are better able to survive when they are active at night than they are when they are active during the day. Large eyes provide them with the necessary visual power to pursue their nocturnal activities, and these activities can most effectively be pursued in a solitary manner or in pairs or in small family groups. These seem to be the facts for the lemurs.

The reverse conditions seem to be equally closely connected. Now, what are the facts for the remaining suborders and families of Primates? Are these facts or is this association of conditions corroborated by the conditions existing in any other group of Primates? It may be said at once that the evidence is strikingly corroborative, and where it is exceptional, very enlightening.

The exception to the rule of having all four variables positively correlated is provided by a single family among the Platyrrhini or Old World monkeys, the Hapalidæ, consisting of the marmosets and tamarins. These animals are about the size of a small squirrel, but they all have small or medium-sized eyes, are diurnal in their habits, and are said to live in pairs or in single families. The two important correlations are here (1) between body size and the habit of living in pairs or in single families, and (2), between diurnal activities and small or medium-sized eyes. I shall return to a discussion of the significance of these facts presently. Meanwhile, we must be grateful to Nature for providing us with exceptional cases, for these often serve to throw light on the relative importance of variables which are otherwise too closely correlated to lend themselves to the necessary separation and analysis.

Finally, and most significantly, among the ten genera of the family Cebidæ (South American monkeys) embracing some ninety-three different species, the species of smallest size (embracing ten species) all belong to the same genus Aotes, the douroucoulis or night-monkeys. These are the only monkeys, among the Cebidæ, which have large eyes, are nocturnal in their habits, and live in pairs or in single families. They are about the size of a squirrel.

All other Primates of the platyrrhine and catarrhine series are of relatively large body-size, with small or medium-sized eyes, are diurnal in their activities, and live in communities or bands. (By a community or band is meant a group consisting of the members of two or more families.)

We have here, then, an almost perfect correlation between (1) body-size, (2) kind of primary social group, (3) waking or sleeping activity habits, and (4) size of eyes.

Small Primates are likely to have large eyes, to be nocturnal, and to live either in solitude, in pairs, or in small family groups. Large Primates are likely to have small or medium-sized eyes, to be diurnal, and to live in bands or communities.

The conditions existing among the marmosets indicate that when small Primates are diurnal their eyes are small or of medium size, and that they retain their habit of living in pairs or in single families.

It need scarcely be pointed out here that even a complete positive correlation does not necessarily imply a causal relationship between the variables found in association. Such an association may be due to still other conditions, and it is a safe general rule to assume that this is the case until every effort has been exhausted to prove it so. In the present case, in virtue of the nature of the data, such attempts to prove the existence of significant additional conditions are not readily feasible. Our task must therefore lie in an attempt to educe the order of most probable relationship existing between the four variables we have noted. In this we are greatly assisted by the apparently aberrant conditions found among the marmosets. From the latter it appears that body size is directly associated with small social groups limited to a single pair or a family, while size of eyes is most directly associated, as would be expected, with type of waking activity.

To conclude, then, the evidence suggests that increase in body size (and, presumably, weight) may have been a potent factor in releasing the early Anthropoidea from their crepuscular habits, by enabling them to hold their own against most aggressors, and that this together with the potentialities released by the assumption of a diurnal life led to the development of more extended social relations with animals of their own species. It is perhaps worth pointing out that this is not a speculation, but an interpretation of facts to which a high degree of probability is attached.

A fuller account of these findings will be published in the *American Anthropologist*.

ADVERTISEMENT OF PROPRIETARY MEDICINES

"MASS OBSERVATION" has issued the results of their investigation among their national panel of voluntary informants of the attitude of these informants to patent medicines. These informants do not represent a typical cross-section of the population, but the majority of them are dissatisfied with the present position and ask for further Government control of the price, sale and advertisement of such products, because they make exaggerated claims, play upon the fears of illness and prevent people from going to a medical man, so that illnesses which might be recognized early, and arrested, become chronic. These informants do not, on the other hand, wish to see medically approved remedies removed from the market.

Emphasis is given to this report by an annotation in the *British Medical Journal* (Sept. 25, 1943, p. 398) which discusses the experiments performed by Ivy, oback and Stein (*Quart. Bull. Northwest Univ. Med. hool*, 16, 298; 1942) with 'Carter's Little Liver ills'. Using dogs, these workers injected the pills solution in alcohol intravenously, or in solution in ater intraduodenally, giving the equivalent of 2–4 ills per dose. None of the doses produced any gnificant increase in the flow of bile or of the essure inside the gall bladder. The makers of arter's Little Liver Pills' claim, says the annotation, at the pills flush the poisons out of the system ith two pints of bile and that they are the standard edical formula for waking up the liver. Each pill, ys the *British Medical Journal*, is said to contain ·25 gr. of Curaçao aloe and 0·0625 gr. of Podophylli sin. The annotation adds: "These experiments int to a distant goal—the authoritative study of e pharmacological action of all proprietary prepara- ons and the unbiased publications of the results".

That the Newspaper Proprietors' Association is ive to the importance of control of the advertise- ent of proprietary medicines is shown by the follow- g rules governing such advertisements which have een unanimously adopted at a recent meeting of the ssociation. They appear in the *British Medical ournal* of October 9, p. 462.

(1) No advertisement will be accepted by the ewspapers represented in the Newspaper Proprietors' ssociation which offers for sale to the public any edicine or treatment which is directly or by implica- on held out in terms calculated to lead to the belief hat the medicine is effective in: (*a*) The treatment f Bright's disease, cancer, tuberculosis or con- umption, diabetes, epilepsy, fits, locomotor ataxy, ataract, glaucoma, disseminated sclerosis, osteo- rthritis, spinal, cerebral and venereal diseases, lupus, paralysis or for preventing any of those ailments.) For the cure of amenorrhœa, hernia, blindness, heumatoid arthritis, or any structural or organic ilment of the auditory system. (*c*) For procuring e miscarriage of women. (*d*) For the treatment of abits associated with sexual indulgence or for any lment associated with those habits.

(2) No advertisement will be accepted from an lvertiser who by printed matter, orally, or in his lvertisement undertakes: (*a*) To diagnose by orrespondence diseased conditions or any particular seased conditions in a human being or to receive om any person a statement of his or any other erson's symptoms of ill-health with the view of lvising as to, or providing for, the treatment of ich ill-health by correspondence; or (*b*) to treat y correspondence any of the ailments specified in ection 1 above.

(3) No advertisement will be inserted containing testimonial other than one limited to the actual iews of the writer, or any testimonial given by a octor other than a recognized British medical ractitioner unless it is manifest that the doctor is ot a British doctor of medicine.

(4) No advertisement will be accepted containing lustrations which are distorted or exaggerated in ich a manner as to convey false impressions.

(5) No advertisement will be accepted which in ny way may lead persons to believe that the product commended emanates from any hospital or official urce or is other than a proprietary medicine adver- sed by a particular manufacturer for the purpose ecified, unless the advertising agent submitting the py declares that the authority of such hospital or fficial source had been duly obtained.

These rules are now in operation in all the London morning, evening and Sunday newspapers and all advertisements will, in addition to conforming to these rules, be submitted to medical scrutiny and the product to chemical analysis if it is considered necessary. This is the first time that the national newspapers of Great Britain have unanimously laid down and insisted on a standard of control over statements and claims made in advertisements.

A SYNTHESIS OF A 42-CHROMOSOME WHEAT

THE solution of the jigsaw-like puzzle of the origin of the 42-chromosome wheats of the 'vulgare' or bread-wheat type has been attempted by various methods. A recent endeavour to synthesize a bread-wheat by crossing *Triticum turgidum* ($2n = 28$) with *Aegilops speltoides* ($2n = 14$) adds a new piece to the puzzle (W. P. Thompson, E. J. Britten and Jean C. Harding, *Canad. J. Res.*, C, 21, 134; 1943). It is generally agreed that the monococcum group of wheats ($2n = 14$) has the chromosome sets *AA* and the majority of the emmers ($2n = 28$) the genoms *AA* and *BB*, while all the bread-wheats have the constitution *AA BB CC*, the *C* sets being derived in some way from some species of the genus Aegilops, one of the species of which, *Aegilops cylindrica*, seems to have the genoms *CC DD*. The new species is the result of an attempt to repeat the hypothetical events in the origin of common wheat by first crossing one of the emmer section with a species of Aegilops with 14 chromosomes, and then producing the fertile amphidiploid by doubling the number of chromosomes with the aid of colchicine.

The new type has leaves with a single line of long hairs on the summit of each ridge, a hollow stem, the collar at the base of the spike open, rounded U-shaped glumes with wide truncated 'shoulders' and weakly developed keels, all of which are regarded as typical bread-wheat characters. In the bearded varieties of the vulgares, the awns are shorter than those of the emmers and in this character too the amphidiploid is near the bread-wheats. The teeth at the apex of the glumes are short and blunt as in most varieties of *T. vulgare*. The hairs of the brush at the apex of the grain are intermediate in number and length between the emmers and the vulgares. The rachis, however, is fragile, with a disarticulation which is characteristic of the emmers, and the slender rachis segments have their tops wider than the bases, as in the emmers.

In undoubled F_1 plants, the pollen mother-cells showed 1–3 trivalents in more than 80 per cent of the cells, while 5 or 6 bivalents occurred in 26 out of 57 cells, and 4–7 bivalents in 51 out of 57 cells. In the pollen mother cells of the amphidiploid plants the greater majority showed a few unpaired chromosomes as well as associations of three or four. 75–95 per cent of the pollen appeared good and about three to a dozen grains were set in most heads. Back-crossing with *T. vulgare* and *T. Spelta* was possible both with the amphidiploid as the male or the female parent, but the resulting grains were badly shrivelled and germinated poorly. Of the 8 backcross hybrid plants obtained, 5 had 42 chromosomes and the remaining three 41, 40 and 39.

Thus it can well be said that a wheat-like species which in most essentials is a vulgare type has been synthesized: a new piece has been found for the puzzle, though whether it has been inserted in the correct place remains to be seen. There occur a number of perplexing difficulties which the authors do not set out. Thus, although they do not find as great a proportion of bivalents as Jenkins in the pollen mother-cells in their undoubted F_1, it is still high. This, together with the report of seven perfectly normal bivalents and fairly regular tetrad formation in the hybrid *Aegilops speltoides* × *T. monococcum* (Chizaki, 1932) and the 6–7 bivalents reported by Lilienfeld and Kihara (1934), as usually occurring in the hybrid *A. speltoides* × *T. Timopheevi* (*AA GG*), are difficult to reconcile with the assumption that *A. speltoides* contains the *C* sets of chromosomes. Again, the authors make no mention of the number of nucleoli in their new wheat. In both *A. speltoides* and the emmer wheats there are four nucleoli (Pathak, 1940), so that the resulting amphidiploid will probably have 8 nucleoli, whereas true vulgare wheats have only 6. It may well be that the new type in reality has the constitution *AA BB A′A′* rather than the elusive *AA BB CC*.

B. C. S.

ROOTS OF MOUNTAINS

PROF. BENO GUTENBERG, of Pasadena, California, has been doing a considerable amount of work recently on problems connected with the earth's crust immediately beneath high mountains. He has investigated in great detail the structure of Southern California as it may be interpreted in the light of data from 'near' earthquakes. In a recent paper he summarizes our present knowledge (much of which is due to himself) concerning the roots of mountains throughout the world ("Seismological Evidence for Roots of Mountains", by Beno Gutenberg. *Bull. Geol. Soc. Amer.*, 54, 473–498; April 1, 1943).

Prof. Gutenberg states that all results based on the study of seismograms of nearby continental earthquakes indicate that below the sediments is a layer in which the velocity for longitudinal waves is between 5·55 and 5·60 km./sec. It is considered granitic. Below it, intermediate layers showing higher velocities definitely show regional differences. Their lower boundary is the Mohorovičić discontinuity, below which a material, probably ultra-basic, in which the velocity is about 8·0 km./sec., is found nearly everywhere. The velocities through the granitic as well as those through the ultra-basic layers are the same in different regions, within ± 0·4 km./sec.

The maximum thickness (60–70 km.) of the 'continental layers' above the Mohorovičić discontinuity thus far has been found under the southern Alps and about the same under the Sierra Nevada. Whereas the root of the Alps seems to be due mainly to an increase in the thickness of the granitic layer, present indications are that the granitic layer under the Sierra Nevada extends roughly down to the same depth (about 20 km.) as generally in Southern California; mainly the intermediate layers are thicker under the Sierra. In other continental regions, the Mohorovičić discontinuity is in general at a depth of about 50 km. under areas with moderately high mountains, and of about 40 km. near oceanic coasts. An especially low value of 30 km. has been found in New Zealand. Under the Atlantic and Indian Oceans these layers have probably an even smaller total thickness and are practically absent under the Pacific Basin. The boundary of the crystalline crust is within the ultra-basic material.

DESIGN OF ALTERNATORS FOR SWITCHGEAR TESTING

A PAPER by V. Easton (*J. Inst. Elec. Eng.*, 90, Pt. 2, No. 16; August 1943) deals with some of the factors which affect alternator design. Due to the rapid growth of interconnexions on many systems during the last fifteen years, the greatly increased voltage and current likely to be caused by a fault at many switching stations has necessitated the design of circuit-breakers of larger capacity, and in turn this has made desirable improved facilities for technical investigations and for proving the rating of the breakers. The paper discusses the mechanical and electrical factors which affect the design of alternators supplying power for switchgear testing, and a review is made of several methods of increasing the output of such alternators, the merits of each being critically examined.

In the section on electrical design the author deals with reactance, time-constants and damping circuits, recovery voltage, and speed of plant and losses. The section on mechanical design covers slot conductors, end windings, foundations and couplings. Finally, the author discusses various methods of increasing output and considers the effect of external reactance, increased initial voltage, shorter duration of test, super-excitation, and parallel operation of plant. All the methods to increase output may be applied to existing plant, the most suitable probably being an increase in the initial voltage or a reduction in the duration of the test period. Super-excitation may also be adopted, but if complete neutralization of the stator M.M.F. is desired the super-exciter set must be of large capacity, probably designed for a high voltage, and the arrangement may be relatively inefficient.

The method to be adopted for an extension to existing plant may be influenced by the arrangement of the sets with which it is required to run in parallel, but for a new installation some degree of super-excitation should be provided. The choice lies between a large excitation set capable of maintaining the stator current at the initial value and a small set with controlled switching to eliminate the D.C component of the stator current and permit the switch under test to be opened a few cycles after the master switch closes. Technically, the former scheme is the more satisfactory from the point of view of the flexibility of the testing procedure, the severity of the test conditions, and ease in interpreting the results. Economic considerations may, however, be of sufficient importance to offset the complications and the reduction in the severity of the test introduced by controlled switching.

RIVER CONTROL IN BRITAIN

AMONG the terms of reference of the Centra Advisory Water Committee was a consideration of what enactments, if any, were required to co-ordinate the various river interests, and the desirability of constituting new river authorities with responsibility for some or all of the functions now exercised by existing bodies. There were found* on examination of the subject, a great many bodies each exercising limited control generally of one or ther aspect of river water. Pollution, drainage, sheries, inland navigation, tidal navigation, orts, water supply, sewage disposal, etc., each as for most rivers a separate supervising body. he complex administration for this diversity of losely interrelated problems has led the Committee o suggest means of more closely co-ordinating dministrative control.

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* Ministry of Health. Third Report of the Central Advisory Wate Committee: River Boards. (Cmd. 6465.) Pp. 77. (London: H.M Stationery Office, 1943.) 1s. 3d. net.

The defects of the present system are most apparent s regards the mitigation of pollution, a problem in hich the local government areas bear no relation to atershed areas. Thus there is a patchwork of conrol, actuated by varying standards of purity, over he same river. Moreover, an overlapping of functions n this and other problems does not encourage ficiency and smooth working. In certain river terests no authority is directly concerned with menities and public use. Again, an authority conrned only with drainage may well interfere with nderground water resources in other parts of the ver valley, and there may be considerable divergence etween the interests of bodies charged with conrvation of fisheries, use of tidal waters, sewage disarge and industrial work.

The Committee finds, however, that the principal efect of the existing system is not the overlapping nction, nor the possibility of conflict between inrests, but the fact that no single body is charged ith the duty of co-ordinating various river interests, r the duty of weighing fully all questions under view and so ensuring that the river water is used the best advantage of all concerned. It suggests, herefore, the formation of new river boards in place f certain of the existing bodies. Tidal waters, except s regards pollution, should be left under the authority f navigation and other similar authorities. Probably he same restriction should apply to inland navigation hich, generally speaking, should be left under the lministration of existing authority. The administrave area of each of the new boards should be a atershed area in the case of the larger rivers, or vo or more watershed areas grouped together.

A map of the twenty-nine suggested river boards attached to the report, which concludes with nsideration of constitution and finance.

A SYNTHESIS OF NEW WORLD ARCHÆOLOGICAL FINDS

O many local publications have been appearing lately, some of considerable interest, that it is relief to turn to a work of synthesis. A recent ublication of the American Philosophical Society *roc. Amer. Phil. Soc.*, "Recent Advances in merican Archæology", 86, No. 2; February 10, 43) is extremely interesting in that it attempts to ing up to date, or rather to the end of 1942, the ore important archæological discoveries in the New orld. There are fourteen articles, and it is to be gretted that space will only allow of one or two of ese to be referred to.

Archæologists interested in Maya problems will rn at once to the first article, but the second, hich deals with Eskimo archæology and its bearing the problem of man's antiquity in America, is also great interest. A new site has been examined, d the culture there discovered (Ipiutak) does not adily fit in with the accepted chronological sequence cultures, although it is clearly related to that known as the 'Old Bering Sea', and may even be earlier in date. Much material is turning up in the Lake Baikal region in northern Asia, and this has been dated as Mesolithic to Neolithic. The finds are definitely earlier than the Bronze Age Glazkovski and Tiverski cultures. These early northern Asian finds recall intimately the early stages of Eskimo cultural development. Indeed, it would seem certain that the two cultural areas can be equated. But neither near Lake Baikal nor in early Eskimo sites have such earlier types of tool as the Sandia or Folsom points come to light, and in the Baikal district only one example recalling the Yuma point has turned up. The Yuma point occurs in American sites later in time than either the Sandia or the Folsom, and it would thus appear that there were folk in America at an earlier date than this Lake Baikal complex, which gave rise afterwards to the Eskimo migrations into the New World. Whether the Sandia and Folsom cultures represent the results of earlier migrations into America from northern Asia—perhaps of upper palæolithic date—remains to be proved. The upper palæolithic finds eastward of Lake Baikal are at present too scanty to furnish any evidence. The very early discoveries at the Sandia Cave may not yet be assimilated by every archæologist, as they are fairly recent news. Articles both on Sandia Cave and on the problem of the Folsom and Yuma points can be read in these *Proceedings*.

A long account of the burial of an early American magician, illustrated by no less than three plates in colour, is of considerable interest.

The above notice mentions only a few of the articles which help to bring up to date the recent archæological discoveries, and the whole forms an important symposium for anyone interested in the archæology of northern America. M. C. B.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Saturday, November 13

BIOCHEMICAL SOCIETY (in the Department of Organic Chemistry, Imperial College of Science and Technology, South Kensington, London, S.W.7), at 11 a.m.—Discussion on "The Tetrapyrrolic Pigments".

At 11.15 a.m.—Prof. D. Keilin, F.R.S.: "Properties and Function of Natural Tetrapyrrolic Compounds".

At 12.10 p.m.—Prof. H. Munro Fox, F.R.S.: "Varieties of Hæmoglobin".

At 1.45 p.m.—Mr. R. Hill: "Tetrapyrrolic Compounds in Plants".

At 2.35 p.m.—Dr. E. F. Hartree: "The Constitution of Catalase".

At 3.15 p.m.—Mr. J. R. P. O'Brien: "The Metabolism of Blood Tetrapyrrolic Pigments".

At 4.30 p.m.—Dr. C. Rimington: "The Porphyrinopathics".

Monday, November 15

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Mr. Otto Popper: "The International Regime of the Danube".

ASSOCIATION OF AUSTRIAN ENGINEERS, CHEMISTS AND SCIENTIFIC WORKERS IN GREAT BRITAIN (at the Institution of Structural Engineers, 11 Upper Belgrave Street, London, S.W.1), at 7.15 p.m.—Dr. O. P. Einerl: "Present and Future Application of Light Alloys".

Tuesday, November 16

ROYAL SOCIETY FOR THE PREVENTION OF ACCIDENTS (BIRMINGHAM AND DISTRICT INDUSTRIAL COMMITTEE) (in the Council House, Birmingham), at 10 a.m.—Conference on "Industrial Safety" (to be opened by Mr. Geo. Tomlinson, M.P.).

At 10.30 a.m.—Sir Wilfrid Garrett: "The Future of Accident Prevention".

At 11.45 a.m.—Mr. W. Higgs, M.P.: "Economics of Safety".

At 2.15 p.m.—Dr. J. M. Davidson and Mr. S. H. Wilkes: "Chemical Hazards—New and Old".

At 3.15 p.m.—Mr. A. P. Young: "Education and Propaganda".

EUGENICS SOCIETY (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Mr. R. M. Titmuss: "Social Environment and Eugenics".

INSTITUTION OF CIVIL ENGINEERS (ROAD ENGINEERING DIVISION) (at Great George Street, Westminster, London, S.W.1), at 5 p.m.—Mr. H. J. E. Carter and Dr. A. R. Lee: "The Use of Cold and Wet Aggregates in Bituminous Construction for Roads and Aerodromes".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Sir Henry Dale, G.B.E., P.R.S.: "Progress in the Treatment of Infections", 3: "Present Developments".*

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Discussion on "The Role of Ultra-High Frequencies in Post-War Broadcasting" (to be opened by Mr. K. I. Jones and Mr. D. A. Bell).

ROYAL PHOTOGRAPHIC SOCIETY (SCIENTIFIC AND TECHNICAL GROUP) (at 16 Princes Gate, South Kensington, London, S.W.7), at 6 p.m.—Demonstration of Eastman High-Speed Camera, Type III, with Films Taken on It.

SHEFFIELD METALLURGICAL ASSOCIATION (joint meeting with the SHEFFIELD BRANCH OF THE INSTITUTE OF WELDING) (at 198 West Street, Sheffield 1), at 6.30 p.m.—Mr. H. F. Tremlett: "Metallurgical Aspects of the Welding of Hardenable Alloy Steels".

CHEMICAL SOCIETY (in the Lecture Theatre of the University, Teviot Place, Edinburgh), at 7 p.m.—Prof. M. Polanyi: "The Strength of Carbon Bonds".

Wednesday, November 17

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. Stuart Hibberd: "The Coming-of-Age of the B.B.C.".

GEOLOGICAL SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Sir Edmund O. Reale: "The Contribution of Geological Surveys to Colonial Development".

ASSOCIATION OF CZECHOSLOVAK SCIENTISTS AND TECHNICIANS (SECTION OF MECHANICAL AND ELECTRICAL ENGINEERING) (at the Czechoslovak Institute, 18 Grosvenor Place, London, S.W.1), at 5.15 p.m.—Mr. J. Pochobradský: "Aurel Stodola—the Teacher, the Scientist, the Man".

Thursday, November 18

CHEMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Mr. E. J. Bowen, F.R.S.: "Wave Mechanics and Colour of Organic Compounds".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir James Jeans, O.M., F.R.S.: "The Methods of Modern Astronomy", 3: "Physical Astronomy".*

INSTITUTE OF PHYSICS (ELECTRONICS GROUP) (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. G. W. Warren: "High Vacuum Technique".

Friday, November 19

PHYSICAL SOCIETY (OPTICAL GROUP) (in the Physics Department of the Imperial College, Imperial Institute Road, South Kensington, London, S.W.7), at 2.30 p.m.—Discussion on "The Measurement of Aberrations, with Special Reference to Photographic Lenses" (to be opened by Mr. T. Smith, F.R.S.)

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Prof. C. E. Inglis, F.R.S.: "Gyroscopic Principles and Applications" (Thirtieth Thomas Hawksley Lecture).

INSTITUTE OF PHYSICS (LONDON AND HOME COUNTIES' BRANCH) (at the British Institute of Radiology and Rontgen Society, 32 Welbeck Street, London, W.1), at 6 p.m.—Prof. W. V. Mayneord: "The Physical Principles of Radium Therapy".

Saturday, November 20

BRITISH RHEOLOGISTS' CLUB (at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2), at 2 p.m.—Commander C. F. Goodeve, F.R.S.: "Rheology and Naval Problems".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

PRINCIPAL OF THE OPENSHAW MUNICIPAL TECHNICAL SCHOOL—The Director of Education, Education Office, Deansgate, Manchester 3 (November 18).

HORTICULTURAL INSTRUCTOR (MALE)—The Clerk to the Somerset County Council, County Hall, Taunton, Somerset (November 19).

EDUCATIONAL PSYCHOLOGIST (WOMAN)—The Secretary, Education Offices, County Hall, Northallerton, Yorks. (November 20).

HEAD OF THE ELECTRICAL ENGINEERING DEPARTMENT—The Secretary, Robert Gordon's Technical College, Aberdeen (November 20).

LECTURER with good workshop experience for the PRODUCTION ENGINEERING SECTION of the Mechanical Engineering Department—The Organizer for Further Education in Rugby, College of Technology and Arts, Eastlands, Rugby (November 20).

SPEECH THERAPIST—The Director of Education, Education Offices, Nelson Square, Bolton, Lancs. (November 20).

ASSISTANT (temporary) to teach MATHEMATICS and other JUNIOR ENGINEERING SUBJECTS—The Principal, County Technical College and School of Art, Newark, Notts. (November 22).

LECTURER IN THE MATHEMATICS DEPARTMENT—The Principal, Heriot-Watt College, Edinburgh (November 22).

ASSISTANT LECTURER IN GEOLOGY—The Registrar, University College, Nottingham (November 22).

ASSISTANTS (temporary) to RURAL LAND UTILIZATION OFFICERS in certain parts of England and Wales (candidates should have a sound knowledge of general agricultural practice)—The Ministry of Labour and National Service, Central (Technical and Scientific) Regis
Alexandra House, Kingsway, London, W.C.2 (quoting Reference
E.A.738) (November 23).

ADVISER IN AGRICULTURAL CHEMISTRY—The Registrar, The Uni
sity, Manchester 13 (November 23).

ASSISTANT (temporary) IN AGRICULTURE at the Somerset F
Institute, Cannington, near Bridgwater—The Clerk to the Some
County Council, County Hall, Taunton (November 24).

EDUCATIONAL PSYCHOLOGIST (full-time) to be responsible for
direction of the Child Guidance Clinics of the County Borough
Lincoln and Grimsby—The Director of Education, City Educat
Office, 4 Lindum Road, Lincoln (November 26).

INSPECTOR FOR MATHEMATICS—The Clerk to the Board, Cen
Welsh Board Offices, Cardiff (November 30).

HEADMASTER OF REPTON SCHOOL (candidates must be gradu
of a university in the United Kingdom or elsewhere in the Bri
Empire, but need not be in Holy Orders)—The Clerk to the Govern
102 Friar Gate, Derby (November 30).

REGIUS PROFESSOR OF ZOOLOGY at Glasgow University—The Pri
Secretary, Scottish Office, Fielden House, 10 Great College Str
London, S.W.1 (January 17).

SENIOR TECHNICAL OFFICER, TANK TECHNOLOGY—The Ministry
Labour and National Service, Central (Technical and Scient
Register, D. Section, Alexandra House, Kingsway, London, W.
(quoting Reference No. D.634).

IRRIGATION ENGINEER by the Government of Northern Rhodesi
The Ministry of Labour and National Service, Alexandra Ho
Kingsway, London, W.C.2 (quoting Reference No. E.784).

FULL-TIME LECTURER IN BIOLOGY, mainly for Zoology, which m
be offered to Degree standard—The Registrar, Municipal Coll
Portsmouth.

ASSISTANT ENGINEER for the Sudan Government Railways—
Ministry of Labour and National Service, Central (Technical
Scientific) Register, Alexandra House, Kingsway, London, W.
(quoting Reference No. E.783).

SPEECH THERAPIST (WOMAN)—The Chief Education Officer, Edu
tion Offices, 215 High Street, Smethwick 41, Staffs.

LECTURER IN STRUCTURAL ENGINEERING at the Constantine Te
nical College—The Director of Education, Education Offices, Wo
lands Road, Middlesbrough.

TEACHER OF MATHEMATICS AND ELEMENTARY SCIENCE up to Sch
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DEAN OF ENGINEERING COLLEGE, Baghdad—The British Cour
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nautical Stores Division under the Government of India—The Minis
of Labour and National Service, Central (Technical and Scient
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HEADMASTER FOR THE TECHNICAL SCHOOL OF THE ROYAL AIRCR
ESTABLISHMENT (candidates should have academic qualifications
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SENIOR DIETICIAN (WOMAN) in the Ministry of Food (candid
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recognized by the British Dietetic Association)—The Secret
Central (Technical and Scientific) Register, Ministry of Labour
National Service, Alexandra House, Kingsway, London, W
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and a TEACHER OF PHYSICS for Junior Work in Technical Day Sc
and Industrial and Intermediate B.Sc. classes in the Technical Col
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INDUSTRY, RESEARCH AND EDUCATION IN GREAT BRITAIN

IT was one of the merits of the annual reports of the Department of Scientific and Industrial Research that they afforded something of the nature of an annual stocktaking of the research effort of Great Britain. The broad surveys which appeared over the signature of successive chairmen of the the Advisory Council, such as Lord Rutherford and Lord Riverdale, rarely failed to point not merely to achievements but also to directions in which further efforts were required. Although the War has interrupted this fruitful and effective method of encouraging research-mindedness, noteworthy efforts at education have been made in this field during recent months. Debates on economic policy demonstrated a widespread realization in the House of Commons that adequate research must be the foundation of an expanding export trade. Dr. P. Dunsheath's lecture to the Royal Society of Arts on "Industrial Research in Great Britain : A Policy for the Future" is only one of a number of occasions when the whole structure and policy of industrial research has come under review.

Two of the most notable have been the debate on scientific research in the House of Lords on July 15 and 20 and a memorandum on the meaning of research for industry prepared by Sir Harold Hartley. Sir Harold Hartley affirms his belief that industrial research will be the vital factor in determining the future prosperity of Great Britain, and his paper is a plea to industry to accept the help which science can give, and for more industrialists to become research-minded. Despite some outstanding exceptions, there has not been in Great Britain a general appreciation of the value of science in industry, and the expenditure on research has been correspondingly less than in Germany or the United States of America. While British men of science have proved in both the world wars that they can more than hold their own if they are given equal facilities and support, it is impossible to avoid the conclusion that if Great Britain is to maintain its position in the world markets, industry must give greatly increased attention to research as soon as the progress of the War makes it possible. Industrialists should be taking active steps now to organize this aspect of their post-war activities.

This same point is well made in an article on "Foundations of Prosperity" in the *Round Table.* On the technical side, it is pointed out, the failures of industry have come mainly from inadequate support of scientific research and from unwillingness or inability to scrap obsolete plant. That is one reason for the concern which has been expressed regarding recent pronouncements as to the post-war policy of the British motor-car industry ; these statements have aroused doubts as to whether the policy is sufficiently bold and forward-looking and not too tied to pre-war ideas, and reluctant to replace out-of-date plant. As a nation we still present a curious contrast between the most outstanding individual achievement in every branch of science, and a certain suspicion and scepticism concerning the practical value of the scientific approach to industrial problems. There are still managements and workers in the iron and steel and engineering industries whose belief in traditional practices constantly obstructs the use of metallurgical or physical knowledge. Lord Listowel has solid ground for his assertion that full employment and better conditions of life after the War largely depend on our capacity to modernize industrial equipment and processes and to improve the quality and quantity of their output, checking the failure to keep abreast of the times which has characterized some fields of industry.

On this question of obsolescence the *Round Table* article makes the important suggestion that while neither Government nor industry alone can provide a remedy for such technical deficiencies, the Government contribution should not only include raising the standard of education and the promotion of scientific research, in national institutions and in the universities as well as by industrial concerns, but also by devising a system of taxation which will encourage instead of penalize the modernization of equipment. There is no more urgent task in administration than the reform of the principles of inland revenue. Taxation has come to be looked on departmentally as an end in itself, and until that notion is killed and the corpus of statutes and interpretations built up around the income tax over a century, and more is swept away and replaced by principles more in accord with the facts and requirements of modern life, it will remain true that the industries most in need of modernization are those least able to afford it.

Sir Harold Hartley's memorandum is strangely silent on this important point; but, almost simultaneously with the *Round Table* article, the *Economist*, in its centenary number, lends powerful support from another outlook to this plea for reconsideration of taxation policy in regard to obsolescence and development. But all three agree on the importance of the obligation of enterprise in industry, and the words of the *Round Table* article might appear equally well in either of the others: "No Board of Directors in these coming years of stress and reconstruction will be acting in consonance with the spirit and needs of the age, or indeed with the interests of its shareholders, unless it puts back into the business a substantial part of the profits to cover research, development and obsolescence. No organized industry can hope to survive in a world market if it falls behind in these matters or is deluded by the Inland Revenue into the belief that advertisement is more than all these things". The same point was well made by Lord Listowel in the House of Lords in urging a steady increase in existing facilities for scientific research into the post-war problems of industry.

That is Sir Harold Hartley's argument, and his review of the present organization of research in Great Britain leads him to make several concrete suggestions. Even the smallest firm should find a place on its staff for at least one man with a scientific training, and should join the research association for its trade. If there is no research association, the trade association should be urged to approach the Department Scientific and Industrial Research with the view forming a research association. If the trade has r trade association and no research association, firm which do not employ a research staff are recom mended to apply to the Federation of British Indu tries for advice. If they are in a large way of busine they are also advised to consider the establishmen alone or with associated or kindred firms, of a researc laboratory. Closer contact between scientific me in industry and those in the universities, and mo integration between research and development a also suggested, but Sir Harold does not mention thr points which were repeatedly stressed in the House Lords: adequate remuneration of scientific worke in industry; undue reluctance to pool informati on new developments; and the lack of appre ation of scientific methods by the higher Ci Service.

It will be noted that Sir Harold Hartley appea to place his main emphasis on the research associatio but it may well be doubted whether, except with th smallest firms, this is anything like the most effecti line of advance. On this point Lord McGowan spo explicitly in the House of Lords debate. While reco nizing the value of a research association where n single unit is in a position to create a research install tion on a suitable scale, and paying tribute to th work of the Department of Scientific and Industri Research in fostering and encouraging the resear associations, he thought that this system of researc while it may play a large part in future developme has a very long way to go before we can be satisfi that it is up to the standard demanded by mode conditions.

The reasons for this position are readily seen. can be maintained with considerable force of arg ment that the true field of work of the resear associations lies in the fundamental investigations the basic problems of the industry—investigatio which require planning and co-ordinating frequent in relation to the scientific research which is p ceeding at the universities and independent resear institutes. There are practical reasons why t research association can never hope to compe effectively with the research department of an i dividual firm or group of associated firms in t investigation of day-to-day problems and existi processes, in the search for higher efficiency, low costs and new and improved products. Yet it exactly on such problems that some research ass ciations tend to concentrate.

This indeed is only what might be expected. association of firms which individually are n research-minded enough to establish their o research departments, in spite of ample resourc are unlikely to take the long-range view and supp the attack by the research association of the fund mental problems on which eventually the prosper or even the existence of the industry may depen Lord Cherwell's statement showed that the Gover ment is aware of the importance of fundamen research and prepared to extend its support, but t mere formation of a research association is only t irst step in a programme of education and inculcating esearch-mindedness. It may well be maintained that he whole experience of the research association movement would endorse the plea for an investigation f taxation methods in relation to research and evelopment for which the *Round Table* and the *conomist* have so boldly called.

We touch here on questions of industrial structure s well as of the organization of research. In reconsidering the structure of industry, this question of esearch is of cardinal importance in ensuring that spirit and policy of enterprise which are essential oth in private industry and in any form of public orporation which may be established to provide afeguards for the public interest. Unless that spirit ervades the management, no change in organization r structure will avert disaster or provide the developments and technical advances on which a policy of ull employment and rising standards of living can e firmly based.

Sir Harold Hartley's memorandum may well prove timely corrective in some of the discussions at resent proceeding in these fields, and it is the more ncouraging to find that many of his points have een made very forcefully in the House of Lords ebate already mentioned. The emphasis which ord Samuel, Lord McGowan and Lord Dawson of enn laid on the importance of the highest adminis-ative positions in government service being open o technical and scientific men who had shown hemselves fit for such work is indeed relevant. Without support from the top we cannot expect that he resources of research associations or of universities ill be adequate for the tasks which now confront hem.

What is most welcome in the attention now being oncentrated on industrial research is the recognition hat this is a matter in which both industry and overnment have responsibilities. In addition to the esponsibility in regard to the Civil Service and dministration just mentioned, the Government must arry a prime responsibility in regard to the adequate ndowment of scientific research at the universities. ommenting on Sir Harold Hartley's proposals, Sir rnest Simon has stated that preliminary investigaons of a committee of scientific men and industrialists t up by the University of Manchester to consider what developments are needed to enable the University to render services to industry equivalent to those ndered by leading universities in America, indicate hat it will be necessary to think in terms of trebling he Government grant to universities.

Whether or not, as Mr. Bruce Truscot has suggested in his recent book, the universities of Great ritain might make a larger contribution to research om their existing resources, a much larger State ndowment is clearly imperative. Lord McGowan as indicated, however, that here also industry has a g part to play. There can now be little doubt that ose who insisted that it should be a condition of otection under the Import Duties Act that the dustries concerned should pursue an active policy research and development were fundamentally ght. Failure to insist on this, for example, in the iron and steel industry, has clearly been unfortunate, and the record of the Import Duties Advisory Committee is largely one of missed opportunities from which the whole country has suffered.

Lord McGowan made the point effectively in urging this as one reason why industry should play its part in encouraging scientific developments in the universities and technical schools of Britain. He pleaded for industry to play its part by means of financial grants, particularly to ensure that equipment is adequate in quality and in amount.

But this question of closer contact between the industrial and the academic worlds to which Lord McGowan referred touches closely the question of education. Mutual discussion between industry and the academic man of science may be largely profitless if the standard of education in industry is not sufficiently high. The extension of scientific academic facilities and of technical schools is a post-war issue of the utmost importance if Britain is to hold her own and realize the possibilities which greater research-mindedness on the part of industry might put within her reach. Lord Maugham commented trenchantly on the absence of reference to science in the White Paper on Education, and there are few signs that the opportunity which is offered to us by the scientific developments in the Fighting Services and the consequent wider interest in technical science are fully comprehended.

Education, indeed, in its broadest sense, is the key to the situation. The education of the industrialist, for which Sir Harold Hartley pleads, is one line of advance. The education of the Civil servant and the opening of the higher posts in the Civil Service to those trained in scientific research is another, and on this point Lord Cherwell's statement for the Government was hopeful. The extension and improvement of university facilities and of those for technical training at all levels is another, and it is clear from recent statements that have been made that this aspect is being borne in mind. Vital as it may be to effect immediate improvements by all these means, to secure a fuller endowment of research and development work, its adequate co-ordination by administrators imaginatively alive to the issues involved—and that at every stage in industry, from management to the operative—and a personnel technically and scientifically competent, ultimately it is on the educational system of Great Britain that sustained progress depends. To fulfil the manifold requirements, the system must provide the State and industry alike at all levels with recruits equipped to face the tasks of the new age and aware of the scientific and technical factors which enter into its social, industrial, economic and international problems, as well as of the human, moral and cultural values. It is only in this way that industry and State can be directed and staffed by those aware of the vast possibilities of research, competent to plan and to execute an adequate policy of research, and resolute to see that it issues both in greater efficiency in industry and also in the wider and fuller enjoyment by society of the resources which science has put at our command.

SEX EDUCATION AND GUIDANCE

MANY centuries have passed since Alcuin of York wrote that "Since the time of King Aelfwold . . . the land has been absolutely submerged under a flood of fornication, adultery and incest, so that the very semblance of modesty is entirely absent", but variations on the same theme are still played to-day. Since the outbreak of the War, indeed, they have been both numerous and persistent. In part, such dismal wailings may be discounted as the product of present-day tension and upheaval, but after all allowance has been made for this, a nucleus of truth remains. It is a fact that conditions of war almost invariably lead to an increase in sexual promiscuity, and even the least bigoted among us can scarcely fail to be disquieted.

But while it is such war-time behaviour, with its resulting increased incidence of venereal infection, which has at long last been responsible for removing the taboo on public discussion of sex and sexual behaviour, the problem is not in essence a purely war-time one. In the long run, our hopes for the development of a healthy attitude to sex in our society must be based not only on economic and social change, but also on rational and fearless education. The importance of the latter is clearly recognized by the Board of Education, and its recent pamphlet on the subject* will be given a warm welcome by all progressive educationists.

For many years individual education authorities, schools and youth clubs have been undertaking sex education, and some have done excellent work in this field. This is, however, the first occasion upon which the Board has given so clear a lead; and many who were wondering whether or not to go ahead will no doubt do so under this new impetus. It is important that those who do should be very careful, in carrying out this most valuable but rather difficult work, that they adopt methods likely to produce the best results. Not all the efforts in this field in the past have been entirely happy in their conception or fortunate in their results, and thereby the cause of sex education has sadly suffered. It is, therefore, particularly gratifying to note that the Board of Education itself proposes "both to conduct a special course in the near future, which it is hoped may help a number of men and women to assist in local courses, and to deal with this matter where appropriate in other courses that they organise". No doubt advantage will be taken of the experience of those who have for some years specialized in this field, and local education authorities are in fact advised to apply for help to the Central Council for Health Education, which has for some time been providing lecturers, literature, films and general advice.

The pamphlet is in the main based upon the results of inquiries recently made by H.M. Inspectorate, and presents an interesting survey of present practice i this sphere. Apparently, about "a third of th secondary schools in the country make a seriou attempt to give instruction", while "the remainin two-thirds of the schools are about equally divide between those who give slight attention to the subject or avoid it altogether". So far as the elementar schools are concerned, "it would appear that in th areas of approximately half the Local Educatio Authorities in England, and to a lesser extent i Wales, there is carefully planned instruction in a least a few of the schools"; while in other areas "perhaps one-third of the country . . . practicall nothing is done". It is interesting also to observ that "approximately three girls' schools include se instruction in their syllabus for every one boys school"—a conclusion that confirms the strong impression to that effect previously held by those wh have been concerned in this work.

Excellent in quality as much of this work i educationists cannot rest content until the great gap are filled in, and the standard of all such teachin raised to that of the best. The facts gathered b the inspectorate make it very clear that the method adopted vary widely, and perhaps this is well, fc we have as yet insufficient experience to lay dow the law about their relative merits. What does see to be clear, however, is that the instruction shoul be fitted as inconspicuously as possible into th ordinary school routine, and that sex education conspicuous in a school only in proportion to t imperfection. In many places, where the staff fe unable or unwilling to incorporate sex education e their day-by-day lessons, recourse is had to the se vices of the specialist lecturers of the Central Counc for Health Education; but this Council itself recognizes that such a method is very far from ideal an can be regarded only as a temporary expedien This makes it particularly important for local education authorities to arrange courses for their teacher both to provide the non-biologists among them wit the necessary factual knowledge, and to make suggestions about methods of classroom presentatio Apart from courses on biology and health educatio generally, special courses on sex education hav either already been held, or are at present bein arranged, for the teachers of Surrey, Middlese West Sussex and Dorset among the counties; Dew bury, Doncaster and Bristol among the coun boroughs; and an occasional progressive urba district like Enfield. It is also clear, from the conferences which have been held elsewhere, th many more teachers' courses will materialize befo long.

So far as the schools are concerned, the mo important task is the presentation of simple b accurate biological information. "But early instru tion in the physiology of sex is only the beginning sex education in the fullest sense. It should b succeeded at the later end of adolescence by i struction and advice directed to the understandi and control of sexual impulse and emotion, leadi on to the establishment of mutual understanding a respect between the sexes, and, as young manho or womanhood is approached, to an adequate preparation for marriage". The early school-leaving age n Great Britain means that for the great majority of children the schools can do little in this respect, but the youth organizations have a great opportunity. Here the objections to visiting lecturers, which are so potent in the case of schools, scarcely apply, and the usual procedure is for a course of three or four talks illustrated by films to be given by a member of the staff of the Central Council for Health Education. Some idea of the extent of this particular part of the work now going on throughout Great Britain is given by the fact that during the six months of April–September 1943, there have been held 578 such meetings, attended by 16,223 young people.

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* Board of Education. Educational Pamphlet No. 119. "Sex Education in Schools and Youth Organizations." (London: H.M. Stationery Office, 1943.) 6*d.* net.

The Board of Education pamphlet emphasizes that youth leaders "themselves require more accurate and comprehensive knowledge than they already possess". "To meet this need both local education authorities and the youth organisations are increasingly arranging short training courses in sex education for leaders, or are devoting attention to the subject at their general youth-service courses." A particularly interesting course was that held recently at Horsham. A carefully selected group of leaders attended a residential week-end school, and at sessions attended by the County Director of Education, Medical Officer and Youth Organizer, a team of speakers dealt with many aspects of sex education in youth organizations. It is likely that as a result of the school, a county panel of recognized lecturers will be drawn up; they should be able to carry out much valuable instruction in the youth organizations of West Sussex.

Particularly in respect of sex education in schools, the fear has sometimes been expressed that there may be parental opposition. Figures collected recently show this fear to be quite unfounded. Some schools and education authorities have, before introducing such lessons, circularized parents of pupils and given them the opportunity of withdrawal. Whether in fact this is a wise procedure is a matter of debate, but the numerical results are quite conclusive. Of 320 pupils from a girls' grammar school in Dorset, only two were withdrawn; of 500 in a similar school n Surrey, four; of 550 in a similar school in Kent, none. A boys' grammar school in Lancashire has given such instruction for some years, with never a single withdrawal; of 470 pupils in a similar school n Surrey, the parents of 380 actually wrote to give approval and to enclose a contribution towards the expenses of the lecturer. The story in senior schools s similar. A Lancashire urban district had twenty-one withdrawals out of 936, and a neighbouring county borough but fifteen out of 2,300. There is ndeed a wealth of support for the pamphlet's assertion that "parents welcome any initiative shown by teachers".

Particularly welcome is the Board's recognition, that "the first responsibility rests upon parents to deal with their children's questions from the beginning, as and when they arise, in a natural manner". This, however, raises a serious problem —that of fitting the majority of parents to do so. It is not usually recognized by scientific men that for nine parents out of ten this is at present rendered extremely difficult, even neglecting consideration of emotional unsuitability, by the simple matter of ignorance of the necessary minimum of technical vocabulary.

It is an unfortunate fact that during the last few hundred years the old Anglo-Saxon terms for the sexual organs and the sexual processes have descended far in the social scale, and in many cases have now reached the gutter. Precisely those parents who would be most willing to answer their children's queries will be most reluctant to do so in the only sexual language they know. A warm welcome must therefore be accorded to the pamphlet's suggestion for "The organisation of parents' meetings, with a view to securing their co-operation in anything that is done through the schools, and to helping them in dealing themselves with their own children in this matter". Actual lectures on the physiology and psychology of sex, and on sex guidance to classes of parents, would also seem worth trying. The children's problems are cropping up at all times, and it therefore seems undesirable that in the long run everything should be left to the teacher.

Perhaps the main criticism that can be levelled against this publication is its almost complete scholastic isolation and neglect of the social forces involved as determinants of sexual attitudes and behaviour. The prefatory note refers to "the immediate problem presented by the increased number of young persons who fall victims to the special temptations and circumstances of war-time", and expresses the excellent hope that further efforts will be made "to bring such persons within the influence of the Youth Service". But there is no mystical quality to the phrase 'youth service' which will enable it to conquer its environment. All sorts of social changes will be needed before sex education can yield its fullest fruits. The economic barriers to early marriage must go, and we must so conduct our society that millions of homes are not periodically broken up. Young people must be given some burning sense of social purpose, some feeling that they can be of real service to the community and be valued by it, some belief in a future for which it is worth while to sacrifice immediate sensual gratification. Sex education cannot thrive *in vacuo*. It must be sex education for a particular social setting.

Some educationists may feel a certain disappointment at the benign impartiality of the Board in this pamphlet, and may regret that more detailed and positive suggestions are not given as to teaching technique. But this would be a matter not so much for a pamphlet as for a book, and even a book could do little more than skim over the surface of the many problems involved. There is, moreover, a real danger in the presentation by a Government department of too detailed suggestions, the danger of stifling local initiative and experiment; and if this pamphlet does nothing more than to stimulate such experiment and initiative, the Board of Education will have rendered a great service.

RECENT ADVANCES IN VIRUS RESEARCH

Virus Diseases

By Members of the Rockefeller Institute for Medical Research: Dr. Thomas M. Rivers, Dr. Wendell M. Stanley, Dr. Louis O. Kunkel, Dr. Richard E. Shope, Dr. Frank L. Horsfall, Jr., Dr. Peyton Rous. Pp. ix+170. (Ithaca, N.Y.: Cornell University Press; London: Oxford University Press, 1943.) 12*s*. net.

THE time is not yet ripe for the production of a comprehensive text-book on virus diseases because virus research is proceeding at such a pace that many accounts are outmoded almost by the time they are published. It is unfortunate that the book under review has been given the title it bears for it deals with very few virus diseases, and those from strictly limited viewpoints. It is a collection of six Messenger Lectures delivered at Cornell University by six experts in different branches of virus research. The founder of the series prescribed its title as "The Evolution of Civilization", and the appositeness of the subjects chosen cannot be questioned. Each author naturally lays particular emphasis upon the more recent developments in his own special field. A more appropriate title would have been "Recent Advances in Virus Research".

No individual can hope to keep abreast of all the literature concerning viruses, yet the interrelationship of recent discoveries in human, animal and plant virology makes it imperative for the research worker to have some acquaintance with the whole. This book is admirably adapted to restore that sense of perspective which is so easily lost during the pursuit of knowledge along a single narrow track, partly because of the breadth of the field covered but even more because each lecturer has such a highly individual outlook and method of approach.

The first chapter, by T. M. Rivers, serves as an introduction by first discussing immunity in virus diseases from a general point of view. Rivers corrects the commonly held, but erroneous, idea that virus immunity differs fundamentally from immunity in other infections; special techniques of study have had to be evolved but only because of the peculiar nature of the infecting agents. The nature of viruses is indeed the *leit motif* of the whole book, and Rivers uses the recent advances of knowledge about vaccinia virus to show that, however simple some of these agents may be, the larger ones like vaccinia may have a structural, chemical and antigenic complexity comparable with that of many bacteria. He concludes that infective agents of fundamentally different natures are to be found amongst the viruses.

In the second chapter, W. M. Stanley deals with viruses at the opposite end of the scale of complexity, namely, those plant viruses which can be obtained, pure, in crystalline form. He is especially concerned with alterations of chemical structure as a key to virus mutation. The idea of mutation being dependent upon modification of chemical structure is no new one, but the crystalline plant viruses have, for the first time, opened up the possibility of direct experimental attack on the problem. The examination of eight strains of tobacco mosaic virus for only five amino-acids and sulphur revealed significant differences, and it is obvious that this line of attack promises fruitful results. It is a long cry yet to the purposive creation of virus variants for prophylaxis by chemical manipulation, but the author envisages the possibility and describes his own attempts to this end by which he has reduced the virulence of a virus for one host species while leaving its virulence for another unchanged.

Chapter 3, by L. O. Kunkel, is devoted to the importance of finding new hosts in virus research, and the thesis is supported by a wealth of illustrations drawn from recent research. Chapters on swine influenza by R. E. Shope and human influenza by F. L. Horsfall give fairly comprehensive accounts of these diseases and are to some extent mutually complementary. Unlike the swine disease, human influenza is not a clinical entity; the term embraces a number of conditions, and Horsfall follows the usual classification into pandemic, epidemic and endemic forms. Research has, perforce, been mainly concerned with the epidemic form because the etiological agents of the other two are still unknown, and the facts thus far garnered have raised as many problems as they have solved. Human influenza was the subject of a recent monograph by Burnet and Clark, and, while Horsfall covers much of the same ground and gives an admirable summary and critical appraisement of the present position, the limitations imposed by a lecture have prevented such exhaustive treatment as was given by the Australian authors. Shope is fortunate in having a much more circumscribed field to survey He gives a detailed account of his own researches which have gone far towards the solution of the epidemiological puzzles presented by the swine disease, namely, the whereabouts of the virus between epizootics, the reason for seasonal incidence, and the means whereby wide dissemination occurs in a very short time. His discovery of helminth intermediate hosts of the virus has led him to a new, unorthodox conception of swine influenza epidemiology, which excludes direct transmission as a major factor and postulates the seeding of a herd without any chronological relationship to the onset of an outbreak The epidemiological patterns of swine influenza and some forms of the human disease are so similar that Shope's work is bound to provide a stimulus for further research on the latter along unorthodox lines.

In the last lecture Peyton Rous gives a masterly exposition of the relation of viruses to tumours The list of tumours in which a virus has been proved to be the actuating cause is not a large one and does not include any mammalian malignant growth, but there is no tumour for which any other actuating cause has yet been discovered. The author emphasizes that the chemical and physical carcinogenic agents are in an entirely different category—he terms them provocative carcinogens—for, once they have provoked malignant potentiality into activity their role is ended, they do not increase in quantity as the growth enlarges and they have no effect in determining the kind of tumour which arises. There is much indirect evidence that viruses may exist and multiply within the cells of a tumour from which no virus can be isolated. Especially significant are the cancers which often arise within the benign rabbit papilloma, which is known to be caused by a virus; virus mutation is suggested as the likeliest explanation, and a rereading of Stanley's lecture with the tumour discussion fresh in mind cannot fail to prove stimulating.

He would be a dull virus researcher who could read this book without feeling an urge to get back to hi laboratory.

WILSON SMITH.

METEOROLOGY AS A CULTURAL SUBJECT

Ways of the Weather

A Cultural Survey of Meteorology. By Dr. W. J. Humphreys. Pp. v+400. (Lancaster, Pa.: The Jaques Cattell Press, 1942.) 4 dollars.

DR. W. J. HUMPHREYS is well known among meteorologists the world over as the author of a number of valuable books on meteorology. In his latest book Dr. Humphreys aims at providing “an easy stairway, or even a gentle ramp for some, in this corner of the temple of knowledge”. Here and there he discusses aspects of the weather which find little or no mention in the ordinary text-book, while the sixteen chapters of this book will give the reader a sound basis for building a fuller structure of detailed knowledge.

The aim of the book is to treat meteorology as a cultural subject, which presents a myriad facets of interest to the intelligent man, entirely apart from any application to the business of life, though these applications are indicated in the course of the book. Technical expressions are almost entirely avoided, even when they might have facilitated the discussion of the point at issue.

Methods of observation are described in an early chapter, and subsequent chapters deal with the disribution over the earth and at different heights in the atmosphere of temperature, water vapour, pressure and wind, the travel of sound through the ir, meteorological optics, electrical phenomena and hunderstorms. The function of the sun as the source f all atmospheric energy is brought out clearly. One of the best parts of the whole book is that which deals with the formation and classification of clouds; this is illustrated by an extremely well-selected and beautifully reproduced series of cloud photographs.

The author draws no distinction between cloud droplets and rain-drops except that of size. It would have been worth while at this stage to give some ndication of Findeisen's theory, according to which the distance through which a drop of water can fall through the air before it is completely evaporated is proportional to the fourth power of its initial radius. Thus, if the relative humidity of the air beneath a loud is 90 per cent, a cloud droplet of initial radius 0 μ will only fall through a vertical distance of about in. before being completely evaporated; a cloud droplet of initial radius 100 μ will fall through a distance of about 500 ft. before complete evaporation ccurs; any droplet having a radius appreciably greater than 100 μ will fall to the ground as rain. This fixes 100 μ as a rational and useful limit between loud and rain. The reader would also have been nterested in Bergeron's theory that the formation f rain-drops large enough to fall to the ground is due to the fall of ice crystals through clouds of liquid roplets. The medium in which the water drops are suspended must be supersaturated relative to ice, so that rapid condensation takes place on the ice crystals, with consequent drying out of the medium and evaporation of the water drops. The ice crystals grow nd fall to the ground, being melted into rain-drops n the way down.

I have few faults to find with Dr. Humphreys' ook. It has achieved its aim to a remarkable degree, and while avoiding difficult concepts has contrived o give the reader a clear picture of many of the phenomena of weather. The author has a scholarly mind, and a pleasing way of quoting passages from the Bible or from the Latin and Greek classical authors when, and only when, they illustrate the point under discussion. Thus on p. 227, in the course of a discussion of St. Elmo's fire, we find the following passage from Cæsar's Commentaries: “In the month of February, about the second watch of the night, there suddenly arose a thick cloud, followed by a shower of hail; and the same night the points of the spears belonging to the Fifth Legion seemed to take fire”. After a careful perusal of this book, the reader will have acquired some idea of what makes the wind blow, why the trade winds blow from the east, why it is generally colder on a hilltop than in the valley, why a rainbow is never seen at noon on the equator, why ‘Aurora's fingers’ are rosy; and if he has sorted out the appropriate factors, he will also have learned how to select the ideal site for a home, either for himself or for his apple trees.

One question recurs to me, as it always does after reading any book which aims at presenting a complex subject in simple terms: Will the reader of this book of nearly 400 large octavo pages really be as non-technical as the author assumes? Is that reader in fact helped by the statement made on p. 128, concerning the molecules in air, that “if 500,000 people were each picking them out at the rate of 100 per minute, day and night, it would take them 1,000 years to accumulate enough to make a volume of the air we breathe as large as the head of a pin”. Would it not be better to give the number of molecules in, say, a cubic centimetre or in a cubic inch, possibly supplementing it by the statement that it is a ‘whale’ of a large number? D. BRUNT.

MOUSE GENETICS

The Genetics of the Mouse

By Dr. Hans Grüneberg. Pp. xii+412+14 plates. (Cambridge: At the University Press, 1943.) 30*s*. net.

THE study of inheritance must always be more laborious than most other forms of biological investigation which concern themselves with only one phase of an animal's whole life-history. It is therefore not surprising that there are only very few animals, and not many more plants, about the genetics of which we know enough to feel confident of having even a crude picture of their commoner modes of variation. Among these animals the mouse holds a very important place. The rapidity of its breeding, the comparative ease of maintaining colonies, and the large number of variations bred by ‘the fancy’, have made it perhaps the favourite mammal for geneticists. It shares, with Drosophila and maize, the distinction of having a ‘hot news’ journal (*Mouse Genetic News*) devoted to the technicalities of its genetics and circulated semi-privately to scientific murophils. A new monograph summarizing the enormous literature which supports the mouse's standing in the world of geneticists will therefore be welcomed, both by specialists, who will find it a convenient summary of their field, and by non-murine geneticists, who want a guide through the tangles of the subject. Both these groups will find Dr. Grüneberg's treatise, with its classified list of 1,141 references, entirely satisfactory for their needs.

“The Genetics of the Mouse” is, however, something more than a merely competent summary of available data. The particular richness of mouse genetics, at its present state of development, lies in its wealth of examples of morphological abnormalities occurring during the development of a mammal, and in this field Dr. Grüneberg is one of the foremost investigators in the world. His account of these aspects of the subject is the fruit of a long and intimate acquaintance with the material, and embodies many original, and to some extent not previously published, observations. It is certain to remain for many years the standard work on the subject.

Grüneberg very justly emphasizes the great interest that many of these developmental abnormalities may have as experimental material for physiological and pathological investigations, in which the purely hereditary side of their behaviour would be of minor importance. His book is, in fact, a storehouse in which biologists of many kinds could find fruitful suggestions for studies in their own fields. The famous example of the pituitary dwarf is an instance which has, of course, already been put to good use by hormone specialists. Similarly, the rodless retina race has been employed in some studies of behaviour, and so have the famous 'waltzer' and 'shaker' strains, though more remains to be done with the numerous pathological variations which are available. There are numerous other types, such as the two forms of hydrocephalus, or the race with a hereditary absence of the corpus callosum, about which we know much less. The extraordinary pathological conditions of the integument in races such as 'naked' and 'rhino', and the lesser abnormalities of hair-growth in the various 'waveds', 'caracul', 'rex', etc., offer another wide field for future investigations; and so do some of the sexual conditions, such as the association of deficient mammary development with hairlessness, the 'imperforate vagina' condition and others. The use of genetical methods in the study of susceptibility to cancer and tumour transplantation in the mouse is, of course, a classical example of such a broadening of the purely genetical outlook. It is the subject of a special section of the book, contributed by two specialists in the field, Drs. Little and Gorer. Unfortunately this is in some ways not so satisfactory as the greater part of the work, perhaps because there is scarcely space to make clear the somewhat complicated situation, or, perhaps, because of war-time difficulties in communication between joint authors on different sides of the Atlantic.

Of all the numerous aspects of biology touched on in the book, that which is closest to the personal interests of the reviewer is the embryological. It would scarcely be possible to better Grüneberg's account of the facts of the development of the various abnormalities; and he can unravel some of the causal sequences involved, such as the consequences of the failure of secondary bone absorption in grey lethals. But on the whole it must be admitted that the genetic abnormalities in the mouse pose many more developmental questions than they answer. Even in so well-investigated a case as the grey lethal, we have no inkling of the relation between the skeletal and the pigmentary effects. Grüneberg, perhaps wisely, makes only a very sketchy attempt to classify the types of developmental abnormality which are encountered. In by far the majority of cases, our knowledge ceases when we have traced the pathological condition back to some developmental process which takes place in a sub-standard way for reasons unknown. In contrast to Drosophila (or plants) there are few cases where one organ is replaced by some other organ properly belonging to another region of the body; there is nothing at all closely corresponding to conditions such as aristopedia bithorax, tetrapter and the rest. Speaking metaphorically, the members of the mouse orchestra do not tend to come in at the wrong time with the right phrase—their fault is a tendency to play out of tune Is this difference connected with a lower degree o functional metameric symmetry in a mammal than in an insect ? Or with a greater elaboration of the evocators or 'switches', which makes it less easy for the wrong key to open the right door ? No answer can yet be given ; that is another, and one of the (to me) most fascinating of the stimulating questions raised by Grüneberg's book.

C. H. WADDINGTON.

KEEPING UP WITH ORGANIC CHEMISTRY

Dictionary of Organic Compounds

The Constitution and Physical and Chemical Properties of the Principal Carbon Compounds and thei Derivatives, together with the Relevant Literature References. In 3 vols. Vol. 1: Abietic Acid—Dypnone. New, revised and enlarged edition. Edited by Prof. I. M. Heilbron and H. M. Bunbury Pp. xvi+1072. (London: Eyre and Spottiswood (Publishers), Ltd., 1943.) £6 6s. net; complete £15 15s. net.

THE original edition of this first dictionary of the kind in the English language was finished at the end of 1937, and it was then hoped to issue revised volumes at regular intervals, beginning in 1939 (NATURE, Nov. 17, 1934; Feb. 29, 1936 Feb. 19, 1938). The outbreak of war interfered with these plans, and in the circumstances it is a remarkable achievement to have produced this new edition of volume 1. The plan of the work remains unaltered and the format is identical with that of the firs edition, except that a thinner paper and narrowe margins have been used. As a consequence, the new edition of volume 1, comprising 1,088 pages, is lighte and more compact than the old one of 726 pages.

The volume has been completely rewritten. The many new entries cover the literature of organic chemistry to the end of 1940, and there are some references to still newer work published in 1941 an 1942; at the same time, certain omissions from the first edition have been remedied. As an illustration of the considerable increase in the number of entries the section from "Carene" to "Carvoxime" has grown from 3½ to 7 pages. In a work of this kin it is particularly difficult to maintain a high standar of accuracy, yet this has been done. It is, indeed something of a feat for a critic to find a formula fc α-cyperone lacking a methyl group, or to discern certain dubiety in the bracketing of carvomenthene with piperitol.

It has not proved practicable under war condition to rewrite volumes 2 and 3. These, of course, ar not so far behind the times as the original vol. 1. As they have been out of print for some time, the are being reprinted with supplementary data co lected since the original publication. Moreove vol. 1 contains cross-references to compounds include in the supplements to volumes 2 and 3. Prof. Hei bron, Mr. Bunbury, and their collaborators have onc more earned the gratitude of the chemical community through their labours in maintaining and improving this invaluable Baedeker of organi chemistry.

JOHN READ.

THE FUTURE OF ANTHROPOLOGY

A CENTENARY meeting of the Royal Anthropological Institute was held on October 30. The first part of the proceedings, at the Royal Society, consisted of addresses on the work of the Institute by Sir John Myres (see NATURE of October 30, p. 493) and on "The Role of Anthropology in Colonial Development" by Lord Hailey. This was followed by a symposium on the future of anthropology, held at the Institute, with the president, Prof. J. H. Hutton, in the chair. Four short papers on different branches of the subject were read, each being followed by a discussion.

It was said that the problems of anthropology are more diversified than those of any other science. Thirty years ago, teachers—notably C. G. Seligman and A. C. Haddon—were still able to survey the whole field, but no one attempts to do that to-day in any comprehensive way. Accessions to knowledge and developments in method have entailed increasing pecialization, and it is now inevitable that different branches of anthropology should be surveyed by different workers. The meeting gave an opportunity of judging how far they have drifted apart, and of assessing the advantages and disadvantages of that process.

The first of the four papers was read by Dr. G. M. Morant, his topic being the future of physical anthropology. Three main branches of the study were istinguished:

(1) Man's place in Nature. It may be doubted whether the further study of living forms—by oologists, anatomists, embryologists or physiologists—will ever throw much clearer light on man's origin, and advances in genetics are not likely to reveal the course of his descent in any detail. More recise knowledge regarding these questions must depend primarily on future discoveries of fossils representing the earliest human and related non-human forms.

(2) The evolution of man judged from his skeletal remains of geological antiquity. Here, again, progress must depend on new discoveries, these being of ar more importance than further speculation regarding specimens already described.

(3) The relationships of populations that have existed since palæolithic times. Methods of interreting the records of series of living people and skeletons have been transformed in the present entury owing to the development of statistical methods and genetics. These necessitate fundamental changes in the classical concept of race in man. It was suggested that two ideas which will have to be abandoned completely are: (*a*) that a race is a group f people separated from all others on account of istinctive ancestry; and (*b*) that analysis of modern populations in terms of 'pure races' presumed to have existed at some earlier time is possible.

Dr. Morant referred next to the provision made for eaching and research in British universities. Before he War, there were in Great Britain three whole-me posts for physical anthropologists—a readership at Oxford, a lectureship at Cambridge, and a lecturehip at University College, London—but no one of hese is actively occupied at present. For several years courses in the subject have been given elsewhere y teachers appointed primarily for other purposes.

Finally, practical applications of the study were discussed. These are concerned principally with: he interpretation of medical and demographic statistics; the provision of equipment for the personnel of Fighting and other Services; the exposure of unscientific racial dogmas.

In his paper on the future of archæology, Prof. Gordon Childe dealt with general aspects of the subject rather than specific tasks which will confront archæologists after the War. Existing human institutions, he said, can only be comprehended in the light of the past, and archæology presents the abstract, and therefore potentially scientific, aspect of human history. The Institute has contributed largely to converting the study into a science in the British Isles.

A workable basis of classification has been established, its three aspects being functional, chronological and cultural. Thanks largely to collaboration with technologists, the functions of nearly all artefacts are now understood. The problems of chronology have also been reduced to order and the framework of a scheme has been set up. New techniques that have emerged in the past two decades—concerned with tree-rings, varved clays and pebble counts—open vistas which must be more fully explored.

The cultural classification is a more recent development. The earlier concept of an evolutionary and linear sequence, which found expression in de Mortillet's system of prehistoric phases and Morgan's stages of social organization, is now abandoned. Culture is now recognized to be adaptation of distinct societies to differing environmental conditions. The change of outlook necessitates re-examination and reclassification of the vast accumulation of prehistoric implements preserved in collections.

The work of classification is so far advanced that sober interpretation may be attempted in the form of generalizing hypotheses which unify a mass of data. Much explanation in prehistory has been undisciplined, such as that which postulated the scarcely credible voyages and migrations of peoples of whom we really know nothing. Theories of diffusion are mythopœic unless they can be substantiated by concrete evidence, such as that provided by skeletal remains or intrusive artefacts.

Archæology is more scientific when it asks not where a society came from but how it attained its peculiar development. New possibilities in this direction have been indicated by the studies of Soviet workers. They involve the total products and refuse of a society which are sampled in the total excavation of domestic sites. The sites should be carefully chosen for the verification of well-considered hypotheses. The methods in question might be extended profitably to cover historical periods. It is absurd that we know more of the domestic architecture of neolithic Thessaly than of Periclean Athens. The approach referred to is not altogether new in prehistory, as it was expounded by Pitt Rivers. Application of the methods to give comparative studies of societies or regions over centuries would go far towards providing a solution of the problem of the nature of progress in material culture.

In his paper on the future study of material culture, Mr. R. U. Sayce discussed principally the developments in museum collections which are most needed. He urged that regional museums, specializing in local cultures, should be encouraged. Some of this kind are already well established in the British Isles and elsewhere. Others should be instituted, such as a museum in Nigeria to illustrate the numerous cultures of West Africa, one in the Sudan and at least one in East Africa. The regional collection should be of vital interest to the people of the country. It helps them to appreciate their past and to gain a wider knowledge of their present condition. It may also foster the development of native cultures. Mr. Sayce stressed the need—so often voiced by anthropologists—for immediate action regarding such matters, since the material is rapidly disappearing.

There should also be more museums having a wider scope at suitable centres in Great Britain, especially in university towns. Useful comparisons may be made between our own craftsmanship and that of peoples in remote parts of the world. Russian museums must have helped to break down psychological barriers between the 'civilized' and 'primitive', and to encourage mutual respect between European and non-European peoples.

We have neglected the study of native arts and crafts. Much remains to be learned regarding the selection and quality of raw materials, the emotional attitudes of the craftsmen, and the efficiency of the implements they use. There is a pressing need, too, for distributional studies. Much work on these lines has been done in America and Africa: in Great Britain we have failed to keep abreast of progress on the Continent. There are few of our own things for which the distribution is accurately known. Field-work at home might deal with such questions as the boundaries of distributions, diffusion in progress, methods by which cultural objects are spread, and factors which hinder their dispersion. Experience gained in examining such problems here would be an invaluable preparation for ethnological work abroad.

The last of the four papers, by Dr. Raymond Firth, dealt with the future of social anthropology. He defined this branch of the subject as the scientific study of human culture. It analyses the nature and meaning of men's rules, conduct and beliefs in different types of society. As world relationships have developed, the scope and methods of the study have tended to change. Anthropologists used to be interested mainly in primitive peoples considered in isolation. With the world-wide extension of trade, political interests and missionary and philanthropic effort during the last century, primitive tribes have lost much of their isolation and many of their ancient customs. The interest of the social anthropologist has therefore shifted towards the study of culture-change, especially the effects of civilization on the comparatively undeveloped tribal societies.

The future will see a still greater interest in social processes and their aims: in how societies change and can be made to change; in what kinds of economic, political and religious organization are most desirable, and how they can best be achieved. After the War, changing conditions will present anthropology with new and more complex problems to study. The peasant societies of Europe and the Far East, as well as those of Africa and the Pacific, will need investigation by experts. At the same time there will be a call for more systematic study of many institutions and beliefs in Western culture. On the practical side, social anthropology may be expected to play a special part in applying its results to colonial problems, though without necessarily subscribing to the colonial idea.

Such future trends will involve more collaboration with other social sciences, and more systematic development of social anthropology itself. More international cross-fertilization of ideas and methods is needed. Planned social surveys can be envisaged, with, say, Chinese, Africans, Americans and Eur peans working as a team, or as a body of adviser dealing with a problem or an area anywhere in th world. Schemes may often be concerned with particular problem encountered in a number societies rather than the intensive study of a sing society. This will mean a more active exchange research workers between countries; more trainin facilities and more research centres, especially i areas outside Europe and America. It should als mean helping the public, by talks and books in no technical language, to appreciate the significance the work of the anthropologist. In time, soci anthropology will be recognized as a necessary aid t the understanding and rational control of man' social life.

The discussions which followed the papers we discursive, as such discussions usually are, but vital issue was raised by Prof. Daryll Forde. H emphasized the need for consideration of the relatio ships between different branches of anthropolog and pointed out that their integration should be th concern of the Institute as a whole. Dr. Firth' comments on this topic must have surprised some his colleagues, since he implied that such integratio is neither logical nor desirable. For him physic anthropology is a branch of biology, archaology subsidiary to history, and social anthropology further removed from either than it is from sociolog There is no reason, he said, why social anthropolog should be considered to have closer ties to physic anthropology than to medicine. These were pr vocative remarks.

Owing chiefly to the limited time at their disposa perhaps, no one of the four readers of the papers ha dealt specifically with the relationships betwee different branches of anthropology, though the referred to this question incidentally. For D Morant, the purpose of physical anthropology is reveal the biological history of mankind, from i source to its latest manifestation in the racial pop lations existing to-day. In his discussion of the lig that the archaologist may throw on the developme of human institutions, Prof. Childe pointed out th there should be collaboration with the physic anthropologist. Their studies have many points contact, and they meet on common ground in co sidering the problem of race and culture. It w also observed that there are intimate relations betwe archæology and the study of the material culture historical times. Mr. Sayce dealt principally wi modern artefacts, but he pointed out that interpr tation of their development and present distributi necessitates study of earlier material. With rega to this point, the attitude of the physical anthrop logist and of the student of material culture is t same. If the one is largely concerned with t bodies of living people and the other with the thin they make, the present is considered by both as t outcome of the past, so that all their problems a viewed in historical perspective. These thr branches of anthropology deal with different kinds subject matter, but the connexions between them a clear.

Group activities of human beings not falli within the scope of the archæologist, and other th those expressed by material articles, have still to taken into account. Dr. Firth defined social anthr pology as the scientific study of human culture different types of society. 'Culture' here was tak to cover 'rules, conduct and beliefs', but not articl produced. The discussion was confined to social processes in existing communities, and nothing whatever was said about any historical considerations. t may be assumed that in dealing with 'culture-change', which was his main theme, Dr. Firth would not consider that the historical evidence of contact between European and non-European peoples in the past few centuries is entirely irrelevant, but he certainly implied that the evidence of earlier 'culture-changes', including all in the archæological sphere, might be disregarded by the student of the modern problem.

If social anthropology is restricted in this way, hen there is obviously a gap in the system. Who is o study the world-wide history and development of social institutions ? British anthropologists of earlier generations supposed that this is the major task of the social anthropologist, so that he would make ontact with the archæologist on one side, and on he other he would interpret existing forms in terms f evidence of a historical kind. Generalizations regarding these matters which were widely accepted t one time have since been discredited. It may be supposed that a revolt against 'evolutionary' theories of social development was one of the factors which made many social anthropologists concentrate on the study of existing societies ; and it may be suggested that neglect of historical evidence makes them ess anthropologists and more students of comparative sociology. This would have been the conclusion of their predecessors.

Another, and more decisive, factor which may be presumed to have disposed social anthropologists of he modern school to neglect historical evidence has been the desire to make their researches applicable immediately to practical affairs. In recent years ppreciation of the value of applications of knowledge gained by students of the life of 'primitive' peoples has been increasing. In his address to the anthropologists at their centenary meeting, Lord Hailey said that those concerned with Colonial ffairs feel that study of the way in which social groups originated has little relevance to administrative problems. But they have far more interest in the recently developed anthropological school which concerns itself not with the origins but with the way n which the groups function. Lord Hailey advocated the encouragement of this school in our universities in the interests of the Colonial Service. But if their numbers and resources are not augmented, there s a danger that all the energy of the academic workers in question might be absorbed in dealing with the practical need. It may be suggested, in the interests of science, that if the Colonial or any ther Government Service expects to receive such ssistance, then it should be prepared to pay for it, either by subsidizing universities for the purpose, or else by founding a State-controlled institute. If his is not done, the gain to the State will be a cultural oss to the country.

The same issue between pure and applied anthropology has affected the physical branch of the subject. Some students of it—particularly in the United States—have devoted themselves to problems having an immediate bearing on practical questions. In so far as such researches are not intended to throw light on any historical topic, it may be questioned hether they can rightly be called anthropological. lternatively, they may be supposed to come within the scope of human or social biology, or human genetics, or eugenics. In Sweden the issue has been resolved in a satisfactory way : "The Swedish State Institute for Race Biology"—to which title "Human Genetics" was added later—was established in 1921. Its first major activity was an anthropometric survey of 47,000 conscripts. The satisfaction of the anthropologist in seeing a type of research which he initiated carried out in such a way must be entirely unqualified.

At the meeting with which this article deals, Prof. Forde remarked that a centenary celebration may be considered as a ritual death and rebirth. It is a time for taking stock of the past and preparing plans for the future. It may be suggested that there are two matters which the Royal Anthropological Institute might well consider at the present juncture. The first concerns the definition of the science of anthropology as a whole, and of the branches into which it can be most conveniently divided in this age of specialization. The relations between these branches might be considered at the same time. The second matter concerns the applications of the science to practical affairs, and the general policy of the academic workers concerned regarding the allocation of their resources to further practical needs, on one hand, and the progress of their 'pure' science, on the other.

GEOGRAPHY AND INTERNATIONAL SETTLEMENT

By W. FITZGERALD
University of Manchester

INTEREST in the contribution of geography to knowledge has been greatly stimulated through the influence of war. It is realized that the organization of the war effort in Great Britain depends on a very careful estimate of the resources of all the belligerent powers. Moreover, in preparation for peace, the planning of community life in its proper relation to environment is now accepted as worthy of serious study. At the next peace conference statesmen will undertake a vast experiment in political geography. The framework of frontiers which they then erect will prove its worth in so far as it meets local needs within the boundary zones and at the same time promotes equilibrium in international relations.

In the application of political geography to the study of international affairs the following arguments, briefly outlined, emerge :

(1) Geography establishes a close relationship between types of human organization and their environments ; and the particular objective of political geography is an investigation of the extent to which the nature of States, together with their organization and interrelations, is influenced by, and adjusted to, conditions of geography.

(2) The political pattern of the world is subject to ceaseless modification, and for two main reasons : (*a*) The factors of physical environment on which the pattern largely depends are themselves subject to processes of change which are beyond man's control. Thus, to take an illustration from the Middle East of the Old World, desiccation of climate in past times had the effect of destroying the prosperity of States, and, indeed, of denuding whole regions of all organized life. (*b*) In the political, as also in the social and economic, evolution of mankind—the adjustment of life in all its varied manifestations—to environ-

ment is itself in process of continuous change. This adjustment is, in part, a conscious selection by man of opportunities offered by Nature. It is not solely a matter of geographical influence, much less of geography acting as an agent of determinism. Man assists in designing his own environment, and does so in the light of experience and of his estimate of the opportunities which the physical environment has to offer. Thus the stage of civilization reached is a factor of primary importance in shaping the character of the adjustment. Moreover, the communities of mankind greatly vary in their methods of response to environment, although care is taken not to attempt a comparison between peoples in respect of their innate capacities. Such an investigation is certainly not for the geographer.

(3) The interrelations of States become ever closer—though not necessarily more sympathetic—as man surmounts the geographical difficulties of distance, climate and terrain. Political isolation is impossible to-day, as all States have been brought to realize.

At times of political re-settlement, such as the period now approaching, the geographical basis of frontiers and their justification receive unusually thorough investigation. It is then realized that the boundaries which divide the sovereign States of Europe are instruments of regional partition which have no sanction in geography. Frontiers in geography are rare, and almost everywhere there is transition from one set of environmental conditions of climate, land-form and vegetation—summarized by Herbertson in the term 'natural region'—to another of contrasted characteristics. Moreover, transition is not confined to the physical environment of man. As all his organized activities—in settlement, economic production, State-building, etc. —are influenced by physical geography, the characteristics of one type of civilization associated with a particular region merge with those of a neighbour-type. Such mergence is at times in defiance of political frontiers which, over long periods, are unable to prevent—though they tend to hinder—the spread of cultural influences from one country to another.

As no sanction for frontiers is found in geography, the term 'natural frontier' cannot claim geographical validity. It is most commonly employed in a military context, and to the soldier signifies a boundary which, of those available, is the most likely to provide an adequate line of defence. Until the advent of air warfare the crest of a mountain-range was considered to be the ideal 'natural frontier'; but configuration is not the only environmental feature which might be the basis of natural divisions. Equally natural would be a line defining the limits of nationality. Similarly, the limit of a coal-field or some other industrial zone is entitled to be termed 'natural'. Obviously, any such line is selected for, and justified by, the particular end which the boundary commissioners have in view, but that is not to say that it is endorsed by geography.

As the world is a whole made up of interrelated parts, political frontiers, however 'natural', are artificial lines of division which obstruct inter-regional co-operation, their purpose being to partition what to Nature is indivisible. Through their influence adjacent peoples are turned away from association with each other, and are led to exaggerate the usually small ethnological and cultural differences which distinguish them. Moreover, as they correspond more with political ideals than with geographica realities they may be opposed to a satisfactor economic and social adjustment of the community t its environment.

In a Europe of rival sovereignties devotion t frontiers arises mainly through lack of confidenc in any safeguard of social and political security othe than military defence; and the defence of frontier is intended to be a guarantee both of the inviolabilit of individual States and of the stability of the politica balance as a whole. There is, however, no possibility of dividing from each other the peoples of th great middle zone of Europe by frontiers which exactl define their limits. The widespread interminglin of populations of various ethnic and cultural origin which is characteristic of European society, ha already occurred before the partition of Europe int nation-States fixed the population of the Continen by restricting inter-regional migration. Furthe there is no geographical correspondence between th distribution of nationalities and the distribution the regions within which population is concentrate The welfare of the Continent depends on an economi integration of its regions, similar to the economi integration which the United States have attained but at the same time the autonomy of Europe's man nationally-conscious communities must be preserve Only on such a basis does European equilibrium see possible.

If ever the European system of sovereign Stat should be replaced by the United States of Europ the nations would relinquish much of their individu claim to sovereignty, while retaining cultural an administrative autonomy. Boundaries would st be required for the purposes of administration, they are required, for example, in the federations the Dominion of Canada and the Union of Sout Africa. Once the idea of national sovereignty removed from the concept of frontiers, they cease be the main source of international dispute, an changes affecting them become matters of compar tively simple local adjustment. The principles which boundary demarcation would then be effecte would have more to do with the economic and soci welfare of mankind than with the claims of nationa ism.

The need of the world is less a partition of terr tories between the Powers according to this or th formula than an ordered redistribution of populati within the habitable regions of the world. T present congestion of certain lands and the emptine of others does not correspond to the distribution the world's potential resources. There are va areas within the temperate and tropical zones t climate, soil and vegetation of which are favourab to human life, but which still lie fallow. Their fro tiers are closed to settlement for a variety of reason among them the desire for racial exclusiveness ar the intention to protect certain economic standar against the intrusion of peoples of low material lev On the other hand, there are large areas of the O World where densities exceed a thousand persons the square mile, and where standards of life a greatly depressed by extreme pressure on the ava able land. Such pressure is, in many instance increasing because of a prolific birth-rate. In cou tries where congestion is very acute, not only intern administration but foreign policy also is affecte and the harmony of international society is enda gered. Unilateral efforts on the part of individu States to ease the situation within their own borde cannot be more than partially effective, and the normal outflow of emigrants in search of new homes is prevented by frontier restrictions, which had become increasingly prohibitive before the War. The settlement of the empty, or half-empty, but habitable lands and a corresponding reduction of density in the congested areas, constitute the supreme task of planning now confronting the world. It is a problem to which the geographers should pay continuous attention.

The demands for 'living-space' raised aggressively by Germany are not derived from an objective study of society and environment. Compared with a number of other countries—some of which she has claimed the right to annex—Germany is not overcrowded. Moreover, it could be shown that the natural endowment of German soil is not inferior to the average for Europe as a whole, and that applied science is capable of raising the productiveness of the more sparsely populated districts of Germany to enable them to support much higher densities without overcrowding.

An unscientific attitude towards 'race', with absurd claims of 'Aryan' superiority and intolerance of their neighbours, combine to explain the German demands for *Lebensraum*. Given the type of mental discipline nculcated by the Nazi creed, such demands are inevitably justified by a philosophy of determinism, which is the sanction of Germany's bid for world hegemony. So is explained the emergence of the pseudo-science of *Geopolitik*, which is little more than the prostitution of the ideas of political geography to the ends of a selfish nation.

It is not on the strictly scientific side of geography —concerned with the accurate location and relaionships of phenomena in terrestrial space—that German education requires fundamental revision. Their cartographical, geomorphological and climatoogical disciplines have nothing to learn from us, and n such respects, it must be admitted, their contribution is not excelled by any other nation. But the Germans have long been under the influence of a mystical conception of the destiny of the Teutonic peoples and of the intention of Providence to grant them a dominating position in Euro-Asia. Their geographical perspective may be unsound; but its error is slight compared with the distortions to which history and anthropology are victims in the hands of Nazi scholarship.

In Great Britain there is little possibility of geographical investigation being tainted with the excesive determinism of the politico-geographical school of Haushofer and his associates. The contacts of British geographers with the Continental philosophers of the subject have shown more appreciation of the nlightened doctrine of Vidal de la Blache—with its insistence on man's freedom of initiative—than of any other. The influence of the German school has been relatively slight; indeed, it is doubtful if the best geographical work in Germany from the ime of Ritter and von Humboldt onwards has been adequately studied in Great Britain. So strong has been the refutation by British scholarship of conceptions of economic and geographic determinism, since they were introduced from the Continent by the historian Buckle and others, that the most distinguished of our geographers cannot be charged with proposing any causal relationship between environment and man's aspirations. (This deserves to be nown so as to correct an impression which may have been left by a contribution to NATURE, **147**, 546; 1941.) There is now the possibility that, in constant danger of the charge of materialism as they are, geographers may omit to state with sufficient confidence their conception of the scope and aims of their subject.

SPATIAL ISOLATION OF SEED CROPS

By GORDON HASKELL

THE sudden increase in the acreage of seed crops in Great Britain has brought with it a number of problems. One of the major problems confronting the seed grower is that of reducing to a minimum the amount of contamination of one crop by pollen from an adjacent one.

There are two methods of tackling this. Zoning is now in force for Chenopods, namely, sugar beet, garden beet and mangels, and is shortly to come into force for Brassicas in the Essex seed-growing areas. The second and more usual way of reducing cross-pollination is by spatial isolation, that is, by isolating the crops at certain guaranteed distances from each other. The following account is a survey of recent investigations to determine the safe isolation distances for the vegetable seed crops of Great Britain[1].

Bees are the chief agents of dispersing pollen of *Brassica oleracea* plants, and wind also carries the pollen of kale and kohl-rabi. This necessitates keeping crops of any two members of the same Brassica group[2] at a considerable distance apart. A spatial isolation of two miles is common, and sometimes only one mile for cabbages and kale. Recent experiments at the John Innes Horticultural Institution[3] indicate that under natural conditions no crossing, or perhaps slight, occurs beyond 80 ft. intervals between radish plots. The usual isolation is not less than 40 rods. Tedin[4], working in Sweden, investigated the danger of crossing in turnip seed production. At 27 yd. between crops he obtained a 1 per cent contamination, and there was no perceptible fall in this value for wider separating distances. Tedin decided that the wind was responsible for carrying this small amount of pollen and that a certain number of insects making long flights could also have transmitted it.

With the exception of the broad bean, the Leguminosæ do not require large isolation distances. Soy beans give between 1–2 per cent natural cross-pollination in the field. But crossing between plants of alternate rows is only 0·16 per cent[5]. The recent work of H. Crebert[6] has shown that broad beans undergo 7 per cent outcrossing in the field and breeders in Great Britain experience 5–10 per cent natural crossing in their crops. Evidence of the correct spatial isolation is not available. Cross-pollination of french beans is effected by thrips, which often occur inside the flowers[7]. Barrons[8], working in Alabama, found that at 9 yd. apart there was only 2·63 per cent natural crossing in the common bean. In England seed growers consider that in most varieties of beans the cross-pollination is negligible; seedsmen do not generally ask their growers to isolate fields of different varieties. Peas are considered to be self-fertile and only a short distance is required to protect them against crossing. A separation of crops by 40 rods assures complete elimination of cross-pollination.

Investigations on outcrossing among members of the Umbelliferæ lag behind those of other groups. It is customary to allow half a mile between different varieties of carrots, but there seem to be no definite figures available for other Umbelliferous crops. Parsnip varieties are usually isolated from each other although pollination within the umbel seems to be the rule; it is also customary to isolate celery and parsley varieties. It is therefore surprising to find so little evidence on spatial isolation of these important crops which include herbs of economic importance such as dill, fennel, carraway and anise.

Cucumbers under field conditions undergo 65–70 per cent natural cross-pollination[9]. A spatial isolation of at least 40 rods, or even more, is necessary to eliminate outcrossing between plots of different cucumber varieties. There is little information available concerning the requisite isolation of marrows.

Lettuces have been the subject of a number of investigations. Thompson[10], working in America, grew lettuce plants side by side without protection from insect visitors. He placed the plants "just far enough apart so that the lateral branches of the seed stalks did not touch". Under these conditions there was 1·33–6·22 per cent outcrossing. Under normal field conditions, therefore, the value would be much less. This supports the practice of British growers of lettuce seed crops who do not subscribe to isolation. The sunflower is generally regarded as a cross-pollinated plant, bees acting as the major contaminating agents. Putt[11] has found the amount of natural crossing is *c.* 70 per cent. Satisfactory isolation distances are so far not reported. Information on the spatial isolation of salsify, scorzonera and chicory is lacking. Although endive is a cross-pollinated plant, there has been little research to determine either the extent of outcrossing or the necessary spatial isolation.

Although the tomato flower is a splendid example of a self-pollinating floral mechanism, even this vegetable is not immune from a small amount of outside contamination. Under field conditions there is 2–4 per cent contamination between rows[12]. More recently Currence and Jenkins[13] have shown that 24 ft. between varieties is sufficient to reduce contamination to a negligible amount. Paschenko, who has made a notable contribution to the literature of floral morphology in the tomato, believes that thrips and not wind are the responsible transmitting agents.

The beets, besides the enforced zoning schemes, require isolation to keep varieties in a pure state. The ordinary beetroot is wind-pollinated, although pollination by insects is also possible. Thrips are important pollinating agents of sugar beets. Increasing the distances between plots definitely reduces the danger of crossing. Beyond about 2½ furlongs there is very little contamination, although it is known that the wind carries beet pollen over a distance of more than two miles. In Great Britain commercial practice requires an isolation of 1,000 yd. between the various crops, but "it became increasingly difficult to obtain isolation"[14]. Hedges definitely act as screens and quite considerably lessen crossing between two plots; there is a definite relationship between the height of the hedges and the reduction in outcrossing. Spinach flowers are wind-pollinated, but there are no satisfactory figures available concerning its isolation. Canadian growers allow at least a quarter of a mile between spinach seed fields and try to keep them out of the path of the prevailing winds[14].

All varieties of onions intercross, so that it is necessary to give a spatial isolation of *c.* 40 rods between plots. Insects normally carry out pollination although wind can transmit onion pollen. Canadian growers consider that half a mile is satisfactory, particularly if there are natural barriers such as a adjacent orchard. Similarly it is customary to giv leeks an isolation distance of 250 yd. But furthe investigations on these two crops would be welcome

Although not a major vegetable seed crop of Britain, sweet corn is gaining in popularity. Wind an gravity are the chief agencies in disseminating swee corn pollen. Haber[15] has shown that "the degree o contamination varied with the distance from th source of contamination". Contamination is eliminated with a separating distance of more than 23 rods But there is a record of a blackbird, which had flow four or six miles from the last maize field it ha visited, that carried the pollen on its plumage. Tree are useful in reducing contamination from nearb fields. A grove of trees four rods wide between field eliminates cross-pollination[16]. Canadian growers us a spatial isolation of one mile and preferably with natural barrier, and in the United States the lega spatial isolation is 40 rods between varieties.

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OBITUARIES

Prof. W. M. Tattersall

WALTER MEDLEY TATTERSALL, who died o October 5, was born on November 8, 1882, the eldes of a family of eight. He was educated at Liverpoo College and the University of Liverpool, where h studied under Herdman, and he graduated wit first-class honours in zoology at the age of nineteen He won a research scholarship at Cambridge an looked forward to the opportunity of working ther as a postgraduate student, but he was obliged t abandon his intention owing to the sudden death o his father. He took an appointment as naturalist i the Irish Fisheries Department in 1902, and here as one of a small band of enthusiasts under th inspiring leadership of E. W. L. Holt, he assisted in th exploration of the rich deep-water fauna on th south-west of Ireland. It was during these year that he first began his studies of the Crustacea Throughout his life he maintained his interest in thi group of animals, and our knowledge of them ha been greatly extended by the remarkable series o papers he wrote.

In 1909 he succeeded W. E. Hoyle as director o the Manchester Museum, where, in addition to hi museum duties, he acted as tutor at the Universitie of Manchester and Sheffield to classes arranged b the Workers' Educational Association and regular took parties of students to Port Erin for courses i marine biology. He obtained his D.Sc. in 191

During the War of 1914–18 he enlisted as a private in the Royal Garrison Artillery and saw service in Flanders and France. He was wounded and gassed in 1917, and later received a commission; but he never afterwards enjoyed robust health and for the last ten years of his life he suffered acutely from diabetes.

In 1922 Tattersall was appointed professor of zoology and comparative anatomy at University College, Cardiff, a post he held throughout the remainder of his life. Starting with only a single post-intermediate student, he and the able staff he gathered around him succeeded in building up a flourishing school of zoology, and shortly before the present War he had sixteen honours and nine research students, with sixty students in the final class. As a teacher of zoology Tattersall had outstanding qualities. With a broad and comprehensive knowledge of his subject he combined the gift of inspiring others with his own unquenchable enthusiasm, and by his simple unassuming ways he won the devotion of his students. He insisted on the importance of field work, and for a long series of years he regularly took a party of students to Loch Ine in Co. Cork. Last May, the twenty-first anniversary of his appointment at Cardiff was commemorated, a celebration attended by 121 of his old students, while eighty others sent cables and telegrams of congratulation.

In the course of his busy life at Cardiff, Tattersall was for seventeen years a member of the Court and Council of the National Museum of Wales, and many universities called on his services as external examiner. He edited the natural history volume of the Glamorgan County History and served as president of the Cardiff Scientific Society. At University College he was for a time dean of the Faculty of Science and latterly deputy principal. He had been a member of the British Association for more than thirty years, and there was scarcely a meeting he did not attend. He travelled with the Association to Australia and Tasmania, to Canada and to South Africa, and went o India as delegate to the Indian Science Congress. He served as secretary and recorder to Section D, of which in 1939 he was president-elect.

Tattersall will long be remembered as our foremost authority on certain groups of Crustacea—principally he Isopoda, Amphipoda, Tanaidacea, Mysidacea and Euphausiacea. He was the ideal systematist, careful, horough and methodical in everything he underook, and with that well-balanced outlook that sees in taxonomy a means to an end rather than the end itself. Above all he was a prodigious worker. Busily occupied throughout his life with important educational work, he always found time to continue his personal studies, and the steady stream of valuable papers which he contributed over a span of forty years is a monument to his industry and ability. Reports by him are to be found among the results of almost every marine biological expedition which has set out from Great Britain during the present century, and from all parts of the world collections were sent to him for examination and description. He was a naturalist in the best sense of the term; interested as much in the development, habits and distribution of species as in their identification, and taking immense rouble, as in his latest paper on the relict fauna of Ennerdale Water, to find a logical interpretation of his results. In addition to his work on Crustacea he made important contributions to our knowledge of the Cephalochorda and Enteropneusta; he was the first to trace the life-history of the periwinkle, and he described the very remarkable larvæ of the starfish Luidia.

At the beginning of the present War he had just completed the manuscript of a volume on the Mysidacea for Bronn's "Thierreich", and since then he finished a report, to which he had devoted four years of work, on a large collection of Schizopods from the American Museum of Natural History. There are hopes that the Ray Society monograph of British Mysidacea, on which he was recently engaged, is sufficiently advanced for publication.

Tattersall married Olive Selden Attride in 1916, and much of the fruitful work that he was able to undertake in his long years of illness is due to her unremitting care and devotion. As a student of science she was able to give him very substantial assistance, and she herself drew nearly all figures which illustrate his papers.

In Great Britain Tattersall seems not to have been appreciated at his full worth: a foreign zoologist once asked me why it was so. Perhaps it was partly because of his unassuming modesty, his lack of 'push' and hatred of self-advertisement, his contentment in the interest of his subject and in the satisfaction that comes of honest work faithfully performed. But in part, I believe, it was because with new methods of approach in zoology we have been led to underrate—as being old-fashioned—the fundamental work of the naturalist in which Tattersall showed such skill. Yet he has left a permanent mark on the literature of his subject, and his name will be honourably remembered when much that is modern has passed into forgetfulness. His many friends will remember him for his genial, good-humoured outlook on life and personal charm, for his intellectual honesty and for the cheerful courage with which he faced adversity. Stanley Kemp.

Mr. J. J. A. Jones

We regret to record the death on November 1 of Mr. John Jenkin Ashton Jones, of the Central Research Department of the United Steel Companies Ltd., Sheffield, and well known in metallurgical research circles.

John Jones was born in 1894, and graduated from Aberystwyth in 1915. Shortly afterwards he joined the Royal Welch Fusiliers and saw active service in the War of 1914–18, during which he was awarded the Military Medal. In 1917 his military service was terminated as the result of wounds, and he joined the Research Department at Woolwich, where he assisted Dr. R. H. Greaves. In conjunction with the latter he presented four papers before the Iron and Steel Institute, of which he became a member in 1920. He was co-author of one other paper, and in his own name contributed six further papers to the Institute.

In 1930 Mr. Jones joined the United Steel Companies Ltd. and, with Dr. T. Swinden, director of research, he took a large part in planning the Central Research Department of that group at Stocksbridge. When the Central Research Department opened he became the manager, a post he held to his death. He leaves a widow and a son and daughter.

Mr. Jones represented the best type of scientific worker, and the quality of his scientific papers needs no elaboration. He did much other valuable work which was not so well known. His quiet yet forceful personality and the multiplicity of his contacts gained him many friends, to whom his many other qualities endeared him. As an example of his modest selfeffacing personality, it may be noted that many who knew him intimately were quite unaware of his distinguished military record. His death will be deeply felt by all who were in contact with him in personal, business and scientific relationships.

WE regret to announce the following deaths:

Dr. Cecil C. Jones, president and chancellor of the University of New Brunswick, where he was professor of mathematics during 1906–31, on August 19, aged seventy-one.

Mr. G. W. Littlehales, hydrographic engineer to the U.S. Hydrographic Office during 1900–32, on August 12, aged eighty-two.

Mr. F. S. Marvin, formerly a staff inspector of the Board of Education, and author of works on the relation of science to civilization, on November 14 aged eighty.

Sir William Noble, a director of the General Electric Co., Ltd., and formerly engineer-in-chief of the General Post Office, on November 10, aged eighty-two

NEWS and VIEWS

A Minister of Reconstruction in Great Britain

THE appointment of Lord Woolton as Minister of Reconstruction with a seat in the War Cabinet follows naturally on Mr. Churchill's declaration in his Mansion House speech on November 9 that it was "a definite part of the duty and responsibility of this National Government to have its plans perfected in a vast and practical scheme to make sure that in the years immediately following the War there will be food, work, and homes for all. . . . No party doctrines or party prejudices or vested interests shall stand in the way of the simple duty of providing before the end of the War for food, work, and homes. They must be prepared now during the War. These plans must be prepared and they must come into action, just like when war breaks out general mobilization is declared. They must come into action as soon as victory is won. On this far-reaching work His Majesty's Government are now concentrating all the energies that can be spared from the actual struggle with the enemy." It may, of course, be inferred that the removal of Lord Woolton from a post which he has filled with such conspicuous success is an indication that Mr. Churchill does not expect the food problem again to become acute. It is equally an indication of the Prime Minister's assent to the principle that preparation for post-war reconstruction has become an urgent necessity and of the importance which he attaches to the Ministry of Reconstruction.

Sir William Jowitt, who as Minister without Portfolio has hitherto been "charged with the duties of reconstruction", will assist Lord Woolton, and the introduction of new blood at the Ministry of Health, which has so much to do with housing, in the person of Mr. H. U. Willink, may be a further indication of the importance now officially attached to reconstruction. The Government's acceptance, in principle, of Lord Balfour's demand last week for early legislation to permit the prompt acquisition of reconstruction areas "at prices related to pre-war values" gave the impression that this obvious and essential measure will soon be made law. The further admission drawn from Lord Snell that "the Government accepts the principle of national planning without qualification", and the Barlow Commission's planning proposals with qualifications, is also reassuring; while in reply to a question from Mr. John Parker on November 10 the Prime Minister denied that the vesting in the State of the rights of development in all land outside built-up areas (proposed by the Uthwatt Committee) was barred as a possible subject of legislation in the present Parliament because of its controversial character.

The precise scope of Lord Woolton's work has not yet been explained. It may be presumed to be administrative rather than the originating of policy, and that Lord Woolton will be principally engaged in supervising and co-ordinating the Government's plans for food, work and homes. Lord Woolton may not have as wide a scope as Lord Addison in 1917 for his task in focusing all the departmental activities, but in sorting out priorities and in seeing that all the necessary legislation is prepared, including laying out the structure of the new social security scheme and forcing concrete decisions on physical planning and in housing, there is ample scope for Lord Woolton's active mind and administrative resource. Whether or not his responsibilities extend to demobilization and to all the policies that are comprised in full employment, it is a great asset to have in charge of reconstruction a man free from Party ties, and the path to agreement on a common programme should be easier.

Centenary of Ferdinand R. Hassler, 1770–1843

ON November 20, 1843, the death occurred of the Swiss-American mathematician and geodesist, Ferdinand Rudolph Hassler, who was the first superintendent of the United States Coast Survey, now the United States Coast and Geodetic Survey. To-day the Survey is responsible for hydrographic, geodetic, tidal, magnetic and seismological work throughout the whole of the United States dominions from Florida to the Aleutians, but when it was founded the United States only fronted the Atlantic seaboard. The suggestion for the Survey came from the American Philosophical Society, the recommendations of which were adopted by President Jefferson, and it was through the Society that Hassler became connected with it when Congress on February 10, 1807, passed the necessary law. Hassler had only been in America two years then, but he had taken with him a library of more than 3,000 volumes and a good collection of instruments, and it was his interest in science which had led to his contact with the members of the Philosophical Society.

Hassler was born in Aarau, Switzerland, on October 7, 1770, and was the son of a well-to-do watchmaker. At the University of Berne he gained a knowledge of mathematics and surveying and afterwards was engaged on a trigonometrical survey of Switzerland He married in 1798, and in 1805, owing to the political unrest of the time, joined a party of emigrants who planned to settle in the southern States. On their arrival in Philadelphia the would-be colonists met with various difficulties, but Hassler's scientific attainments stood him in good stead. Hassler's plans for a coast survey were adopted, and he was appointed to start the work. There was, however, much delay. Having during 1807–9 held a chair of mathematics at West Point Military Academy and during 1809–11 a chair of natural philosophy, in the latter year he was sent by the Treasury to England to purchase instruments. Owing to the War of 1812 between Great Britain and the United States, it was three years before he was able to return to America. The survey was actually started under Hassler's superintendentship in 1816, but two years later he was deprived of his post owing to new regulations which allowed only naval and military officers to be employed. During 1819 he was astronomer to the party sent to settle the north-eastern boundary, but then he was thrown completely on his own resources. For ten years he farmed, somewhat unsuccessfully, in New York State, taught and wrote mathematical text-books. For a time, too, he was employed at the New York Custom House, and then in 1832 when the Survey was reorganized—its work had been practically suspended—he once again became its superintendent. Though sixty-two years of age, he entered upon his work with enthusiasm, assembling the necessary instruments, training assistants and commencing operations in the field. In this work he was engaged until his death at the age of seventy-three at Philadelphia.

Hassler's memory was honoured at the centennial commemoration of the Survey, and in 1929, Prof. Florian Cajori, the historian of science, of the University of California, published his biography under the title "The Chequered Career of Ferdinand Rudolph Hassler". In spite of many troubles—domestic, financial and administrative—Hassler left his mark, and it has been said that "Time has justified the soundness of his ideas", and that "the extension of the survey of the coast to the present day follows his plan, and the field work he carried out more than a century ago is of such high precision that it still forms part of the basic network". As State after State was added to the country, so the work of the Survey extended. Under Hassler's successor, Alexander Bache, the electric telegraph was used in the determination of longitude, and under the third superintendent, Benjamin Peirce, the triangulation was carried from the Atlantic to the Pacific. In the nineteenth century the Survey was responsible for the standard weights and measures; but in 1901 a new department was founded for this work under the title of the United States Bureau of Standards. The centennial celebrations referred to were held in Washington under the presidency of the superintendent, Mr. E. Lester Jones, the President of the United States, Mr. Woodrow Wilson, being among the speakers. A memorial volume was issued, and this contains a portrait of Hassler.

Wellcome Veterinary Research Station

THE Wellcome Foundation has acquired Ely Grange Estate, Frant, Sussex, for the purpose of extending the veterinary research now carried on at the Wellcome Physiological Research Laboratories, Beckenham, Kent. The need for accommodation where experiments can be carried out on farm animals has been felt for some time. The estate will be known as the Wellcome Veterinary Research Station and the resident veterinary surgeon will be Mr. S. L. Hignett, who will be responsible to Dr. R. F. Montgomerie, veterinary research director at the Wellcome Physiological Research Laboratories, where veterinary research, particularly on the laboratory side, will be continued. The full development of the Station at Frant will be delayed until after the War, as the mansion, which will be converted eventually into laboratories, is requisitioned by the Government; but the extensive and modern farm buildings will be occupied and used at once. A start has been made by the acquisition of a herd of pedigree Ayrshire cattle. In addition to the main purpose of the Station, there will be accommodation for the breeding of laboratory animals on a large scale. It is hoped to establish a number of pure lines for this purpose and to do work on genetics in connexion with the breeding of these animals.

Post-War Needs of Universities in Great Britain

SIR JOHN ANDERSON recently stated in answer to a question in the House of Commons that the constitution of the University Grants Committee has been under consideration for some time, and he hopes very shortly to announce the appointment to the committee of a number of new members. As regards the equipment of universities to deal with the post-war situation, the universities themselves have been studying the various problems which will face them after the War. The Committee of Vice-Chancellors and Principals has asked the University Grants Committee to undertake a review of these problems in order to form a considered estimate of the need for increased assistance from the Exchequer. This request will require to be considered as a matter of urgency by the reconstituted Committee; meantime, the universities are being asked to formulate their post-war needs so far as they can be estimated in present circumstances.

Replacement of British Museum's Foreign Books

A GENEROUS offer to replace, so far as possible, the many volumes in the section of non-English books and periodicals which have been destroyed by enemy action in the British Museum has been made by the Allied Governments in London. The offer was put forward by Dr. Philip Argenti, honorary attaché to the Greek Embassy, at a recent meeting of the Books and Periodicals Commission of the Conference of Allied Ministers of Education. Representatives of the Allied Nations pledged their governments to replace, after the War, as a gift, to the best of their abilities, the periodicals and books in their respective languages damaged or destroyed by air attack. The Museum has been invited to submit a list of such periodicals and books to the Commission, classified according to their languages.

The Newcomen Society

THE Newcomen Society met for its annual general meeting on November 10 at the Northampton Institute, London, when the report of the Council for the past year was submitted, and the election of officers took place. The Society has continued to expand, and on September 30 the membership stood at 3,092, irrespective of fifty-five libraries which receive its publications. Owing to the very large increase in membership in North America, the rules of the Society have been amended so that branches overseas can elect their own members and manage their own finances, thus avoiding unnecessary correspondence and expense. The subscription has been raised from £1 to £1 10*s.* for those who elect to receive the *Transactions*. The president for the coming year is Mr. William M. Vermilye, of the National City Bank, New York, who has been treasurer of the American branch for some time. In spite of the difficulties due to the War, a good programme was carried through, and the report contains the titles of seventeen papers and addresses which will ultimately be published in vol. 23 of the *Transactions*. Vol. 21 is in the press and it is hoped will be issued shortly. At the close of the business, special reference was made to the unceasing efforts on behalf of the Society of Dr. H. W. Dickinson. After the business was concluded Mr. R. P. Howgrave-Graham gave a lecture on "Engineering in Early Warfare", the devices of centuries ago being illustrated from documents and pictures.

A New Source of Vitamin C

THE *Biochemical Bulletin*, No. 27, May 1943, published by the Sino-British Co-operation Office, includes among other items of interest an article by T. M. Chen, S. Ho, K. M. Hsieh and T. Shen on "A Very Rich Source of Vitamin C: the Wild Fruit of Emblic from India and S. China". It was thought that this wild fruit might be used as a cheap and convenient source of vitamin C for the Allied Armies in this theatre of war. The tree, *Phyllanthus Emblica* L., bears the fruit, which is "fleshly, depressed, globose, ¾ in.–1 in. diameter, obscurely 6-lobed". The juice is very sour and astringent but contains about ten times as much ascorbic acid by indophenol titration as lemon juice, an average figure of 921 mgm./100 ml. juice being given. This is qualitatively supported by guinea pig tests. It is not toxic for humans, who probably utilize it to the same extent as the crystalline vitamin.

Miners' Welfare National Scholarships

THE trustees of the Miners' Welfare National Scholarship Scheme invite applications for a limited number of university scholarships for award in 1944; there are, in addition, a limited number of exhibitions available for award to the most meritorious of the unsuccessful candidates for scholarships. Candidates must be either workers in or about coal mines in Great Britain, or sons or daughters of such workers, and should not normally be less than seventeen years of age on January 25, 1944. Forms of application and full particulars may be obtained from the Secretary, Miners' Welfare National Scholarship Scheme, Ashley Court, Ashtead, Surrey. Applicants for forms must state whether they apply as workers in or about mines or as children of such workers; those who come within both categories should apply as miners. Applicants already at a university should state, when applying for forms, whether they are first-year students. Application forms must be returned by January 25.

Comet Daimaca

I.A.U. CIRCULAR No. 965 announces that an orbit has been computed for this comet by Mr. Naur from three observations at the Observatory of Bucharest on September 9, 10 and 11. The elements of the orbit are given below.

$$\begin{array}{lll} T & 1943\ \text{Aug.}\ 21{\cdot}538\ \text{U.T.} & \\ \omega & 36^\circ\ 02{\cdot}0' & \rule{0pt}{0pt} \\ \Omega & 82\ \ 15{\cdot}1 & \\ i & 161\ \ 15{\cdot}7 & \\ q & 0{\cdot}75812 & \end{array} \left.\begin{array}{l} \\ \\ \\ \end{array}\right\} 1943{\cdot}0$$

From these elements the following ephemeris has been computed. As the orbit has been derived from short arcs, the figures given below cannot be accepted as very accurate. The comet was stated to be mag. 10 on September 18, when its distances from the earth and sun were 0·32 and 0·92, respectively. As it has receded considerably from the earth and sun since that date, it must be a faint object now, probably about mag. 16.

Ephemeris

Date 1943	R.A. h. m.	Dec.	ρ	r
Nov. 16	18 48·2	11° 56′	2·107	1·658
20	18 51·5	12 25	2·229	1·713
24	18 54·6	12 49	2·342	1·764
28	18 58·0	13 10	2·459	1·823

Announcements

PROF. A. V. Hill, secretary of the Royal Society, is to visit India to advise on problems of scientific and industrial research in relation to reconstruction problems and the co-ordination of such research in India with that elsewhere. His tour is being undertaken at the invitation of the Government of India and with the consent of the Royal Society.

SCIENTIFIC men and many others will learn with much pleasure that Prof. Niels Bohr, of the Institute of Theoretical Physics, Copenhagen, has succeeded in escaping from Denmark and has reached Great Britain.

THE Council of the Royal Meteorological Society has awarded the Symons Gold Medal for 1944 to Dr. C. W. B. Normand, director-general of observatories in India. The medal is awarded biennially for distinguished work in connexion with meteorological science.

SIR GEORGE THOMSON, professor of physics at the Imperial College of Science and Technology, London, has been appointed scientific adviser to the Air Ministry. He will be responsible for examining air operations from the scientific aspect, the methods, weapons and equipment employed, and for advising the Air Staff and other Air Ministry departments on these matters. On all questions affecting radiocommunication and radiolocation Sir George Thomson will work in consultation with Sir Robert Watson-Watt, scientific adviser on telecommunications.

MR. GEORGE HURST has been appointed lecturer in mining and mine surveying in the University of Sheffield. The Rockefeller Foundation has renewed its grant to the University of Sheffield of £400 for research in biochemistry for a further year beginning October 1, 1943.

THE Huxley Memorial Lecture of the Royal Anthropological Institute will be delivered by Prof F. C. Bartlett, professor of experimental psychology in the University of Cambridge, in the rooms of the Royal Society on November 23; he will speak on "Anthropology in Reconstruction".

THE Spanish Cultural Institute at Buenos Aires has recently dedicated a histological laboratory to the memory of Ramon y Cajal; it is under the direction of Prof. Hortegan, one of his pupils.

ERRATUM. In NATURE of November 6, p. 540 col. 2, in the communication signed by Prof. E. F Burton, the size of the fibre used is given as "approximately 0·7 mμ in diameter"; this should be "0·7 μ".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

J. B. Hannay and the Artificial Production of Diamonds

REFERRING to Dr. C. H. Desch's article on this subject in NATURE of August 7, p. 148, I wish to put certain recollections of my own on record.

During the years 1885–96 my father, the late Lord Rayleigh, was one of the secretaries of the Royal Society, and not infrequently mentioned in the family circle incidents which had occurred in connexion with the Society's business, though of course he never gave the names of referees. In particular he spoke a good deal about J. B. Hannay's claim to have produced diamonds, though he never expressed any personal judgment on the matter. It would not have been in his character to do so, without personal investigation.

Hannay sent to the Royal Society a further communication on the artificial production of diamonds at a much later date than that of his published paper on the subject, certainly later than 1890—perhaps about 1894. It may be in the Society's archives, which are at present inaccessible. My father, as secretary, had to deal with it. He made it clear that among the members of the committee of papers (I believe this committee was in fact the same body as the Society's Council) there was distrust of Hannay's good faith. Rayleigh personally found him plausible. Hannay, he said, wrote that the non-publication of his paper seemed to imply disbelief in his good faith, and that as he had offered to demonstrate the matter he thought that this was rather hard. Rayleigh was inclined to agree that it was hard. In Hannay's earlier work, only very occasional success was claimed, and under these conditions a demonstration would scarcely be practicable. I do not know whether at the later period he claimed uniform success. However, the reason why his offer to demonstrate was not accepted was that it was not thought that any demonstration carried out by Hannay could satisfy the sceptics, and no one seems to have undertaken to repeat the work independently.

Hannay wrote a paper "On the Microrheometer" (*Phil. Trans.*, **170**, 275; 1879) which deals with viscosity. This is commented on by R. E. Barnett (*Proc. Roy. Soc.*, **56**, 259–261; 1894), in a paper inspired by T. E. Thorpe, and communicated by him. Barnett gives a very unfavourable analysis of Hannay's work. Since Barnett's paper is not at present easily accessible, owing to libraries having put the volumes of periodicals away for safety, I think some extracts from it may fittingly be quoted.

Hannay gives the rate of flow of various liquids through a capillary tube of stated dimensions. These measurements are not reduced by him to give absolute values of viscosity and thus to admit of easy comparison with the measurement of others, but Barnett points out that all the necessary data are given for such a reduction, which he proceeds to make. He says: "On comparing these results with the values given by Poiseuille Slotte, Sprung, and Thorpe and Rodger as tabulated below (II), it will be seen that Mr. Hannay's observations yield discordant, and indeed, utterly absurd, values for the viscosity of water. At 0°, for example, the viscosity would appear to be below that of any known liquid, and at 6° it becomes *nil*.

"As a matter of fact, it is physically impossible to pass a volume of water such as Mr. Hannay employs under a pressure of 1 m. of water through a capillary of the dimensions given in the time recorded. At 20°, for instance, the time of flow required under these conditions would be about 4600 seconds instead of 131·3 seconds as stated.

"In the light of these results, it would seem to be premature to discuss Mr. Hannay's observations on saline solutions, or to criticise the generalisations he deduces from them."

I have not been able to discover that Hannay made any attempt to reply to this apparently very damaging criticism.

He also wrote a paper on the metallurgy of lead which was read before the Royal Society on April 15, 1893 (see the *Proceedings*), but not published. This paper was, I believe, judged not to have been written in good faith. It is almost certainly still in the Society's archives.

I think that attention should be directed to these facts which, though perhaps not decisive of anything relating to the diamond problem, may nevertheless help in forming a provisional judgment. If Hannay was after all right, they will at least be a contribution to scientific history. The incident about viscosity seems to show clearly enough that his critics had something more than prejudice to go on.

RAYLEIGH.

Terling Place,
Chelmsford.
Oct. 23.

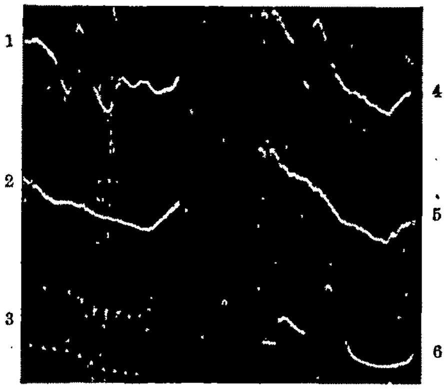
Single-Fibre Response from an Intact Animal

IT is rather difficult to obtain electrical records of the activity of a single nerve fibre, because there are usually present some hundreds of other nerve fibres the contribution of which must be eliminated, and because the shunting of the active fibre by inert tissues or tissue fluid reduces the available action potential to vanishing proportions. It is therefore essential in most cases that the recorded fibre be fairly well isolated both physiologically and electrically, and we are not aware that any records have hitherto been published showing single fibre responses obtained from an animal which has not been dissected nor operated upon in any way.

The median giant fibre in the nerve cord of the common earthworm, *Lumbricus terrestris* L., is especially favourable for such a record, for it may be physiologically isolated from other structures and it has such a large cross-section area that a fair amount of shunting may be tolerated[1].

If a normal lively worm is used the nerve activity is accompanied by muscular action which complicates the record, but if the worm lies in a glass tube just large enough to contain it, it remains quiescent and the record is fairly simple. The nerve is stimulated by a shock applied to the anterior end of the worm, and the record is obtained from leads passing through the glass tube and making contact with the worm's body in the middle region. These leads connect through a balanced amplifier to a cathode ray tube with time base synchronized with the nerve stimulus.

The first record shows the effect of a just threshold stimulus; the least diminution of stimulus gives the



second record. The response therefore exhibits the all-or-none relation to stimulus-strength, it also persists unfatigued by a tetanus of 20 per sec. and is conducted at the same rate as the impulse in the median giant fibre of the nerve cord. This result therefore strongly favours the view that the wave in record (1) is the action potential of the median giant fibre or of structures connected therewith. The grounds upon which we believe that the record does contain the action potential of this fibre itself are these.

The area of cross-section of the median fibre is 0·01 sq. mm., that of the worm filling the glass tube 20 sq. mm. Assuming the mean specific conductivity of the worm to be half that of the giant fibre, the electrical shunting would reduce the recorded wave to 1/1,000 of the nerve membrane potential of 0·1 volt. Hence the recorded wave should be 0·1 mv., which is seen to be of the right order from record (3), which gives a calibration wave of 1,000 cycles at 0·1 mv., peak-to-peak.

The worm is now withdrawn from the tube, opened by a longitudinal incision, and the nerve cord is carefully dissected out and placed in Ringer's fluid. The carcass is replaced in the tube and stimulated as before, but the record shows no wave and is not here reproduced. The carcass is now withdrawn and the nerve cord replaced in it and re-inserted in the tube. The physiological connexions from nerve to worm are now, of course, all destroyed, but the electrical shunting is approximately the same as initially, and records (4) and (5) show the effects of a shock just above and just below threshold, with recording conditions the same as in record (1). The main wave of the first record is repeated, but the subsequent small waves are absent. Finally the carcass was removed, and the nerve cord alone stimulated to give the last record taken at much reduced amplification.

Now this last record is certainly the wave from the median giant fibre, as may be shown by microdissection[2]. Thus the wave in record (4) is clearly the same, but more highly shunted by the carcass. Hence the main wave of record (1) is simply the action potential of the single median giant nerve fibre, and this is followed in the intact animal by other waves with which we are not here concerned.

W. A. H. Rushton.
H. B. Barlow.

Physiological Laboratory,
Cambridge.
Oct. 24.

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[1] Eccles, J. C., Granit, R., and Young, J. Z., *J. Physiol.*, **77**, 23P (1933).

[2] A paper including the identification of potential waves in the worm's isolated cord is being prepared by one of us.

Osmotic Regulation in *Sabella pavonina*

The Sabellidæ are one of the few families Polychæte worms which have successfully penetrate into fresh water. One of us has previously observe at Loch Ine, Co. Cork, that *Sabella pavonina* Sa occurs in places in which, at low tides, it is subjecte to conditions of low salinity. It seemed of interes to know whether this worm has any power of 'osmoti regulation', and whether the highly developed pa of thoracic nephridia play any part in such regulation. We have carried out some simple experiment on these points.

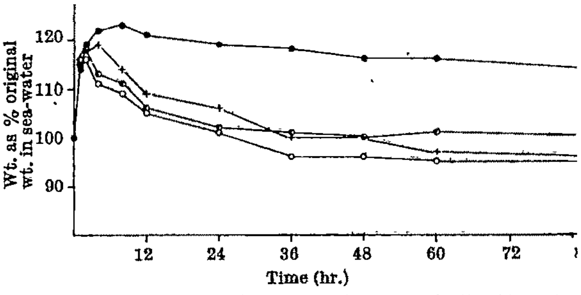
Active regulation in a marine invertebrate may b recognized by following the changes in weight whic result from placing the organism in dilute sea-wate If the animal can regulate, it will retain its origin weight or regain it within a short period. In th following experiments changes in weight of Sabell in different concentrations of sea-water have bee observed.

Preliminary experiments showed that it wa possible to dry Sabella while still in its tube an obtain consistent weighings in a series of drying It was also shown that the weight of the tube di not alter significantly in twenty-four hours on bein moved from sea-water to tap-water. All experiment were consequently carried out with the worms stil in their tubes after these had been trimmed and an attached growths removed. The water in which th worms were kept was changed every twelve hours The temperature varied between 15·2° and 17·6° C

To study the capacity of the worms to regulate the change in weight of individual worms in norma 80, 60 and 40 per cent sea-water was followed fo thirty-six hours. In 80 per cent sea-water the worm regained their original weight within twenty-fou hours; in 60 per cent sea-water the worms rapidl deteriorated in condition, shed their crowns and di not return to their original weight; in 40 per cen sea-water the worms died within twenty-four hour It may therefore be concluded that Sabella has onl limited powers of regulation when transferred suddenly to diluted sea-water.

In order to see whether the thoracic nephridia ar important in regulation, the effect of removing th segments containing these nephridia was studied. A this operation also involves removing the crown, th effect of the absence of this organ was also examined.

Four groups of three worms each were used (*a*) normal worms; (*b*) worms whose crown had bee cut off; (*c*) worms whose crown, thorax and firs three abdominal segments had been cut off to remov the whole of the thoracic nephridia; (*d*) worms fro which about fifteen of the posterior segments ha



●, worms without thorax; ×, worms without crowns; ○, worms without tail segments; ◐, normal worms.

been removed; these were to act as a control against possible effects due to cutting the worms.

These various amputations were performed about sixty hours before the beginning of the experiments, and the worms were kept in running sea-water until required. All experiments were carried out in 75 per cent sea-water. The worms in each group gave consistent results.

The variation in weight of these groups of worms with time is shown in the accompanying figure. It will be seen that while normal worms, those lacking their crowns and those lacking the posterior end all regain their original weight within 36 hours, the worms lacking the thorax show relatively little recovery within 84 hours. It therefore appears probable that the large thoracic nephridia play an important part in the 'osmotic regulation' of *S. pavonina.*

Our thanks are due to the director and staff of the Marine Biological Station at Plymouth for their hospitality to us while carrying out these experiments.

D. W. EWER.
R. F. EWER.

64 Queens Road,
Richmond, Surrey.
Oct. 10.

Siderocytes in Mammalian Blood

FOLLOWING the work of Grüneberg[1], I decided to investigate the possibility that the siderocyte might be a degenerating cell, and that the iron might be catabolic in nature. Investigations in stored blood yielded the following results and conclusions.

Siderocytes appear in large numbers in stored blood of cats, dogs and human beings. Apparently all the cells go through a phase as a siderocyte, and it is possible to demonstrate that the siderotic granules are extruded from the red cell. Concomitantly there is a fall in total blood pigment of between 2 and 7 per cent and a corresponding increase in non-hæmoglobin plasma iron and a bilirubin-like substance. The change is affected by the availability of oxygen, inhibited by storage at low temperature, and accelerated by heat and chemical agents. Phenylhydrazine is one of these agents. The change can be effected once only, and after the granules have been extruded the erythrocyte becomes susceptible to phagocytosis.

Carbon monoxide produces a partial inhibition, but the presence of leucocytes does not influence the production of the siderotic material. Fragility changes also occur, and resistant cells resembling "target cells" (Barrett[2]) appear after the extrusion phenomenon.

It is concluded that the siderocyte is not essentially a young cell; that it is probably the stage before the cell is removed from the circulation; that it probably appears in the blood of all mammals; that the iron is catabolic, and that it is closely related to, if not identical with, the 'easily-split' blood iron studied by Legge and Lemberg[3].

A detailed account of the work will be published elsewhere.

ROBERT A. M. CASE.

Department of Pathology,
The Medical School,
University of Birmingham,
Birmingham.

[1] Grüneberg, H., NATURE, 148, 114 (1941); 148, 469 (1941); *J. Genet.*, 44, 264 (1942).

[2] Barrett, A. M., *J. Path. Bact.*, 46, 603 (1938).

[3] Legge, J. W., and Lemberg, R., *Biochem. J.*, 33, 754 (1939).

Fragility of Erythrocytes in Hypotonic Saline

AN interesting point in connexion with hæmolysis is the variation in the resistance of erythrocytes obtained from the different species of animals towards a particular hæmolysin. It was Rywosch[1] who first attempted a sort of generalization in this connexion by pointing out that the series obtained by writing down the names of common laboratory animals according to the order of resistance of their erythrocytes to hypotonic saline is just the reverse of that obtained by ranging them according to their resistance to saponin hæmolysis. Various suggestions were put forward from time to time to explain this inverse relation, which suggested the possibility of the existence of some factor within the corpuscles which operated in a reverse manner with respect to the lysins concerned.

Subsequent work on the subject, however, showed that Rywosch's contention is neither strictly true for all hæmolysins[2], nor is it applicable to all species of erythrocytes[3]. While working on the fragility of the erythrocytes obtained from some common laboratory animals, in hypotonic saline, it struck us that some erythrocytes known to be of very small size, such as those of sheep and goat, were very fragile, while others of bigger size, such as those of man, dog, etc., were far more resistant.

A closer examination of our data showed that the fragility of the erythrocytes of the species of animals studied, namely, guinea pig, human being, monkey, dog, rabbit, buffalo, ox, cat, sheep and goat varied inversely as their respective average diameter. It remains to be seen whether this relation is a general one and true for all species of erythrocytes.

A. C. ROY.

School of Tropical Medicine,
Calcutta. July 30.

[1] Rywosch, *Pflügers Arch.*, 116, 229 (1907).

[2] Ponder and MacLachlan, *Brit. J. Exp. Path.*, 8, 267 (1927).

[3] Ponder, Salsow and Yeager, *Biochem. J.*, 24, 805 (1930).

Determination of Ascorbic Acid in the Presence of Sulphur Dioxide

WHEN an equal volume of 3 per cent hydrogen peroxide is added to a slightly acidified ascorbic acid solution, no appreciable effect on the indophenol titration value is observed, unless iron or copper salts are present. The end-point is a permanent pink colour deepening very slowly on standing. With sulphited fruit and vegetable extracts the sulphur dioxide is converted into sulphuric acid, and the true ascorbic acid value is rapidly obtained on titration. When lesser quantities of peroxide are used, the titration values are slightly lower, and the pink colour deepens more rapidly. Apparently, re-oxidation of reduced indophenol takes place during the titration, along with reduction of the reformed indophenol by ascorbic acid still present. When 1·5 per cent peroxide is present in solution, this effect is negligible. The method has been used successfully for the last three years.

Full details of these observations will be published elsewhere.

L. F. LEVY.

Chemical Laboratories,
Department of Agriculture and Forestry,
Joubert Street North,
Johannesburg. Aug. 16.

Constitution of Calycanine

SOME time ago, on the suggestion of Prof. A. R. Todd, calycanine was examined by X-ray methods[1,2] in order to decide whether a constitution originally suggested by Barger, Madinaveitia and Streuli[3] for a molecule $C_{16}H_{10}N_2$ is in harmony with the crystallographic symmetry and the unit cell dimensions. That investigation established the approximate dimensions of a monoclinic unit cell as $a = 13 \cdot 7$ A., $b = 4 \cdot 45$ A., $c = 9 \cdot 7$ A., $\beta = 107°$, and showed that the space group is $P2_{1/a} - C^5_{2h}$, provided that a few very weak reflexions are neglected. If these reflexions are taken into account, it was suggested that the above cell should be regarded as a pseudo-cell, the true unit cell having a doubled c-axis, $2 \times 9 \cdot 7$ A. Fairly detailed suggestions were advanced as to the probable crystal structure, but the chemical synthesis which Prof. A. R. Todd intended to carry out has not been completed because of the War.

Recently, Prof. Todd pointed out to us that a totally different molecule $C_{21}H_{15}N_3$ has been proposed by Manske and Marion[4], and suggested that our X-ray data might enable us to decide unequivocally whether this new molecule can be regarded as a possible alternative to the molecule $C_{16}H_{10}N_2$. We have therefore re-examined our original X-ray data, and have supplemented it with new photographs from different crystalline specimens, with the following results.

The dimensions of the monoclinic (pseudo) cell have been determined more accurately as $a = 13 \cdot 7$ A., $b = 4 \cdot 45$ A., $c = 9 \cdot 8$ A., $\beta = 110 \cdot 5°$. The density of calycanine is $1 \cdot 34$ gm./c.c., so that the mass of this unit cell is 750×10^{-24} gm. The masses of molecules $C_{16}H_{10}N_2$ and $C_{21}H_{15}N_3$ are 379×10^{-24} gm. and 510×10^{-24} gm., so that this cell would contain $\frac{750}{379}$ or $\frac{750}{510}$ molecules, that is, $1 \cdot 98$ or $1 \cdot 47$ molecules, according as one formula or the other is selected. Thus within the accuracy of our measurements this cell may contain either two molecules $C_{16}H_{10}N_2$ or $1\frac{1}{2}$ molecules $C_{21}H_{15}N_3$. If this is the true unit cell, the second alternative can be rejected, since a unit cell cannot accommodate a fractional number of molecules.

In general, an approximate determination of the cell dimensions and density would suffice to decide between alternative molecular formulæ ; in this case, however, it happens that a cell with doubled c-axis (as suggested in our original examination of calycanine[1,2]) would contain a whole number of molecules (four or three) for either of the molecules proposed. It therefore becomes necessary to consider very carefully the significance to be attached to the additional weak reflexions which originally led us to propose a true unit cell with doubled c-axis.

Our new photographs again show additional weak reflexions, but, partly because of the shape of these diffraction spots, partly because of their positions in the oscillation photographs, and partly because of the difficulty we have found in systematizing their appearance in photographs from different crystalline specimens, we now incline strongly to the view that they arise from one or more differently oriented crystalline fragments attached to, or grown as part of, the main crystal exposed to the X-ray beam. Because of the peculiar optical properties of calycanine[1], such crystalline fragments are not detected by the usual microscopic examination. The possibility of a true unit cell with doubled c-axis is not definitely excluded; but we do not now consider that there is any very definite evidence for its existence, and if the *true* unit cell has $c = 9 \cdot 8$ A., then the formula $C_{21}H_{15}N_3$, suggested by Manske and Marion, is apparently excluded, while the formula $C_{16}H_{10}N_2$ suggested by Barger, Madinaveitia and Streuli and by Prof. Todd is acceptable. The detailed discussion[1,2] of the probable crystal structure is unchanged in essentials, though slightly modified in detail, if the small cell ($c = 9 \cdot 8$ A.) is the true unit cell.

If, however, we still take the cautious view that the true cell may have the doubled c-axis, it is still necessary to consider under what conditions three molecules ($C_{21}H_{15}N_3$) could be accommodated in it. It appears that this would necessitate the selection of *either* a triclinic space-group *or* a monoclinic space-group without $\{h0l\}$ halvings, so that in either case well-established features of the crystal symmetr must be left out of account. No such difficulties arise, of course, in placing four molecules ($C_{16}H_{10}N_2$) in the larger cell.

We may summarize by saying that all the evidence, whether direct or circumstantial, is satisfactoril explained if the molecule is $C_{16}H_{10}N_2$; but that a molecule $C_{21}H_{15}N_3$ can only be brought into harmon with observation by the adoption of a series of unusua and unlikely suppositions which still leave unexplained certain prominent features of the experimental data.

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College of Technology,
Manchester 1. Oct. 1.

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[1] Hargreaves, A., thesis for Ph.D. degree, University of Mancheste (1940).

[2] Hargreaves, A., and Tavlor, W. H., *J. Sci. Instr.*, 18, 138 (1941)

[3] Barger, G., Madinaveitia, J., and Streuli, P., *J. Chem. Soc.*, 51 (1939).

[4] Manske, R. H. F., and Marion, L., see Craig, *Ann. Rev. Biochem.* 11, 572 (1942).

Non-Solar Planetary Systems

OBSERVATION has revealed the existence of at leas two planetary systems attached to binary stars ver near our solar system[1]; and the suggestion that ther are numerous planetary systems in the universe gain ground. It is interesting to examine the differen conflicting theories of the origin of the solar systen in the light of these observations.

On the tidal theory of Jeans and of Jeffreys planetary systems originate only at the rate of abou one per 5,000 million years. Taking the generall accepted short time-scale for the age of the univers —an interval between 10^9 and 10^{10} years—we fin that there can be at most two planetary systems i the galactic system, on Jeans's theory. The probability of collisions is still less on Lyttleton's binar star collision theory[2], and there is scarcely an chance for the formation of a planetary system.

On Banerji's Cepheid theory[3], in which the sola system is supposed to originate from the oscillator instability of a Cepheid due to the gravitationa attraction of a passing star, the probability of formation is very much greater, as a grazing or even clos encounter is not necessary in this theory. In fact Banerji concludes his theory with the following words "One conclusion seems to be irresistible. If the theor be correct in its essentials, there may be more planet ry systems than at present supposed". The recent observations support Banerji's conclusion.

The detection of planetary systems in binary stars also lends support to the Cepheid theory of the origin of binary stars recently advanced by me[4]. Owing to radiation of energy and consequent increase of angular velocity, a Cepheid was supposed to break up into a double-star system. There is a chance of planets being formed from the filament connecting the two stars.

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[1] See NATURE, **152**, 66 (1943).

[2] Lyttleton, R. A., *Mon. Not. Roy. Astro. Soc.*, **98**, 536 (1938).

[3] Banerji, A. C., *Proc. Nat. Inst. Sci. Ind.*, **8**, 173 (1949).

[4] Sen, H. K., *Science and Culture*, **7**, 582 (1941–42).

Propagation of Potatoes

DR. L. G. G. WARNE[1] is to be thanked for pointing out Loudon's writings on this subject. The works of J. C. Loudon (not Louden) indeed contain references to emergency methods of potato propagation which recent authors in several countries had thought to be new, even if these authors recognized approximaions to some of these methods among the practices of their more economical forefathers. Thus already in the first edition of "An Encyclopedia of Gardening", the date on the title page of which is given as 822, there appear in one form or another all the notes and quotations given by Dr. Warne[1] from the 871 edition, while again in the first edition of "An Encyclopedia of Agriculture" (1825) Loudon mentions among means of propagation having strenuous support in some quarters "on the ground of experience . . . small cuttings, sprouts, shoots, or even nly the eyes or buds".

Three points call for further comment:

(1) Following a later edition of "An Encyclopedia of Gardening", Dr. Warne writes, "the sprouts generlly found on store potatoes in spring may, when carefully planted in loose well-prepared soil, be made o yield a crop"—whereas the corresponding remarks in Loudon's first edition read, "the sprouts which are generally found on store-potatoes in spring, and picked off and thrown away as useless, *will*, when carefully planted in loose well-prepared soil, *yield a crop*; and this crop will be fit for use a little sooner than one produced from cuttings or sections of the same tubers" (the italics are mine). In this connexion it may be added that my own tests with detached sprouts[2] have been successful again this year.

(2) Dr. Warne further quotes from Loudon, "In making the sets or sections reject the extremes or watery end of the tuber" (extreme is in the singular in both the 1822 and 1850 editions of "An Encyclopedia of Gardening"). This is the antithesis of the basis of the widely publicized Russian method which exressly advocates use of the rose or 'top' end as eing the most active part of a large tuber. However, after the removal of this end and, with it, of the dominant sprouts which are also the most active in the production of growth-retarding substance[3], sturdy productive shoots may be obtained also from the 'heel' (proximal) end of the tuber as well as from the lateral eyes.

(3) Scientific literature, however old, can scarcely e dismissed as 'dead' unless it is wholly superseded r proved to be ill-founded. Nowadays, with the rapid strides and great expansion of the plant sciences, it has become practically impossible for even the most active exponent to 'keep up' in more than an ever-narrowing field of specialization; yet many workers have, of necessity or because they feel it to be their duty, from time to time to go outside their own immediate field. All the more easy, then, to miss pertinent references and repeat the work of others unnecessarily.

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[1] NATURE, **152**, 450 (1943).

[2] *Gard. Chron.*, Ser. 3, **113**, 36 (1943); NATURE, **151**, 587 (1943).

[3] *Amer. J. Bot.*, **29**, 558 (1942).

International Languages

RECENT references to international languages in NATURE bring home the necessity of a more thorough inquiry into their possibilities, and into the causes that have so far precluded their wide use. There can now be no doubt that artificial international languages have been constructed that can be learnt in a very small fraction of the time required by any natural language. In spite of this, their anticipated use in international communication has not become general.

A common reason given for their adoption is that they can serve as a tool for international organizations. It is here that the barrier to their use is apparent, since for the last generation international organization generally has been under a cloud.

If after the War we put aside the national rivalry of the last interbellum, its place will need to be taken by international organizations of a robuster nature than hitherto, including both organs of government and cultural international societies. These, if they are based on continuous popular activity, will need a language for their use. (It is less certain that specialized international vocations, such as trade in defined channels, will create a demand for an international language, and the same probably applies to occasional conferences and to the study of foreign countries in detail.) Which international language is to be used must depend on the users. The language for a European or American-European federation might well consist of roots from European languages. A union centred on the English-speaking peoples might well use one based on English. It is conceivable that several might be in use simultaneously in the parliaments of different federations or by different cultural organizations. In view of the ease with which they are learnt, even this would be a gain on the present position, while it would also provide an experimental basis for future work on international languages.

But if one international language is to receive enduring and universal recognition, we require a stable international political and cultural balance, and to know something of the relative importance of the different national cultures therein. How far is this about to be realized? At present we can make some estimate of the future importance of some of the protagonists of this War. Only to a less extent can we foretell the importance of the countries of Asia, South America and Africa. Is it possible to make a reasonably good forecast, to get it accepted, and so to decide the type of international language likely to secure lasting adoption?

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James Prescott Joule and the Unit of Energy

ALTHOUGH it appears from earlier letters[1] that no definite agreement can be reached about the pronunciation of 'Joule', the following points may be of interest concerning a possible origin of the name and of its different pronunciations. According to A. Schuster and A. E. Shipley[2]: "Joule's name appears to be derived from 'Youlgrave', a village in Derbyshire where his family originally resided". It would, perhaps, be more correct to say that both 'Joule' and 'Youlgrave' had a common origin, the former in the English or Scandinavian personal name 'Iola', the place-name then meaning 'Iola's grove'. A. Mawer and F. M. Stenton[3] give this meaning, though E. Ekwall[4] suggests instead, 'yellow grove'.

Various early forms of the place-name have been noted; for example, 'Yolegrave' (1259) and 'Jolgreve' (fourteenth century), and there are many more recent forms. Indeed, the Rev. P. Hadfield, vicar of Youlgreave, has kindly informed me that he believes there are about forty different spellings to be found in the registers and old churchwardens' accounts, a few examples being 'Yolgreave', 'Yolegrave', 'Yoolgrave' and 'Yoolegrave'. These forms seem to indicate variations in pronunciation. At present 'Youlgreave' is pronounced as in 'pool' and 'grave', though the inhabitants who speak the dialect pronounce it 'Yolgrav', as in 'doll' and 'have'—this on the authority of Mr. Hadfield. He states, further, that between 1750 and 1790, the name 'Joule' is found frequently in the registers always with that spelling. He does not say whether he has carried his investigations back to an earlier date. The Joule family had a mill at Alport in Youlgreave parish, and about twelve years ago a person named Joule visited Youlgreave; he claimed to be a descendant of the original family and was writing a book thereon.

Finally, Mr. Hadfield gives the pronunciation of the personal name as 'Jole', but himself thinks there is no direct connexion between the names 'Joule' and 'Youlgreave'.

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[1] NATURE, 152, 354, 418, 479 (1943).

[2] Schuster, A., and Shipley, A. E., "Britain's Heritage of Science" (second edit., 1920), 40.

[3] Mawer, A., and Stenton, F. M., "Introduction to the Survey of English Place-Names" (1924), 104.

[4] Ekwall, E., "The Concise Oxford Dictionary of English Place-Names" (1936).

IF the desire is to pronounce the name as it was pronounced by the family and by the friends of Dr. Joule, there can be no doubt it is 'Joole', so as to rhyme with cool, tool or rule. Professors of the University of Manchester, in the 'eighties of last century, such as (Sir) Henry Roscoe, Balfour Stewart, (Sir) Arthur Schuster and Osborne Reynolds, all friends and some close friends of Dr. Joule, all pronounced his name in this way. Forty years ago, when as chairman of a committee for erecting a memorial to Dr. Joule in Sale Park, I met his son, Mr. B. A. Joule, he told me 'Joole' was the right pronunciation, and that in old family deeds the name was written 'Youle', like the name of the village Youlgreave in Derbyshire in which the family lived It would be interesting if the upholders of the pronunciation 'Jowl' would cite their authorities.

It may be worth recording the opinions of Mr Joule as to the published photographs of his father The beardless face at forty-five years of age in th engraving in the memoir by Prof. Reynolds h thought too long, while the bearded face publishe by NATURE and reproduced in vol. I of Joule' "Scientific Papers" he thought good. A still late photograph by Lady Roscoe, said by Reynolds to b "particularly good", is reproduced in Sir Henry Roscoe's "Life and Experiences" (Macmillan, 1906)

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THE workers in physics and engineering, respectively, in the University of Edinburgh, who wer contemporary with Joule, were Tait and Fleemin Jenkin. Tait was a perfervid supporter of correc pronunciation of proper names: witness his jok regarding his fellow pupil at the Edinburgh Academy Tate, afterwards archbishop, as a man who did no know how to spell his own name.

In the course of a prized twenty-year fellowshi with Tait, wherein Joule and his work were referre to with at least annual frequency, the pronunciatio I heard Tait use was invariably that which rhyme with 'pool' or 'cool'. There can be no doubt that thi was Joule's own, I feel sure.

The testimony of relatives of Fleeming Jenki would be of much value.

W. PEDDIE.

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"Timbers of the New World"

IN his review of Record and Hess's "Timbers the New World"[1] Mr. Alexander L. Howard devot half of a long paragraph to a mild reproof of t authors for saying something which actually the never said. He writes: "The authors state '*Swieten* [is] the source of the only and true mahogany', whic pronouncement may be correct, and also may not' The text (p. 366) reads: "*Swietenia,* the source the original or true mahogany".

There is enough evidence produced (p. 369) th the name mahogany was originally (1671) and st is applied to a tree which since 1760 has been know to science as *Swietenia*. The expression "original true" was meant to convey the meaning that "tru mahogany is the kind to which the name mahoga was first applied, just as the orginal or true cedar *Cedrus*. Thus it is only through misquotation that mere statement of fact opens "a very controversi subject". The senior author has publicly express his opinion on this subject, but not in "Timbers the New World".

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[1] NATURE, 152, 144 (1943).

THE NEW ALGEBRAS

PROF. E. T. WHITTAKER'S presidential address to the Royal Society of Edinburgh, delivered on October 25, on "The New Algebras and their Significance for Physics and Philosophy", contains a characteristically lucid account of the main features of non-commutative algebra and its application to modern physics. Its significance for philosophy follows perhaps by implication; but it is to be regretted that, presumably through limitation of space, this interesting aspect of the subject received no specific treatment.

It is appropriate that the occasion of the address hould fall almost exactly a hundred years after the discovery of quaternions by Hamilton, for this event, as Prof. Whittaker points out, marked the beginning of the emancipation of algebra from the confines of classical ideas, according to which algebraic symbols necessarily obeyed the rules of numbers. Quaternions were devised to represent *operations* (actually operaions of spatial rotation, but the general principle involved is capable of much wider application), and he order of performance of two operations, unlike the order of multiplication by two numbers, has in general an effect on the result obtained. In the developments of the new idea, such as Boolean algebra, Pierce's logic of relatives, Whitehead and Russell's logic, and Cayley's matrix algebra, the symbolism traditionally employed for elementary processes with numbers is adopted for different, though somewhat analogous, processes with operators, so that, for example, abC, which in classical algebra stands for the product of a, b and C and is identical with baC, stands in operational algebra for the operation b performed on C and the operation a on the result. It is not, in this case, normally equivalent to baC.

Prof. Whittaker gives some interesting examples of this generalization of symbolic processes, and then introduces the conceptions of modern physics in which scope has been found for its application. The older physics sought to interpret physical events in terms of moving mass-points, and for this interpretation the algebra of numbers was adequate. The refined experiments now possible, however, show that such an interpretation is not admissible for the extremely small entities with which modern physics is concerned. We can no longer think of those entities as particles. "We have no right to postulate the existence of entities which lie beyond the knowledge actually obtainable by observation, and which have no part in the prediction of future effects. Thus the classical concept of a particle must be discarded; in its stead there has been introduced a new fundamental element in the description of the external world, which is called a *state*". States are "events which extend over more than one point of space and more than one instant of time and which yet are *ultimate* events; that is, they cannot be analysed into anything simpler than themselves".

For the representation of states, numbers are inappropriate. The position and momentum of an ultimate physical entity can no longer be regarded as separate quantities, each specifiable by its intrinsic numerical measure. They have to be taken together and represented by a joint symbol, and the problem s to find symbols the rules of manipulation of which it them to represent the physical situations which actually occur. It turns out that a new algebra of the type introduced by Hamilton, in which 'multiplication' is not commutative, meets the case; it is the matrix algebra of Cayley. This algebra "is, in fact, the symbolism appropriate to things that cannot be measured exactly", although, of course, all observable results obtained by its use must agree with the facts of observation.

Prof. Whittaker gives an example to show how the idea of an operator may be regarded as an extension of the idea of an ordinary number, thus justifying the use of the word 'multiplication' for what are essentially two different processes. In this connexion an illustration occurring in Kelland and Tait's "Introduction to Quaternions" is worth recalling. (Incidentally, Prof. Whittaker speaks appreciatively of Tait's efforts to make known the importance of quaternions.) The extension of the idea of multiplication from whole numbers to fractions involved a generalization as difficult to understand in its day as the extension to operations now is. Originally, multiplication implied a process of addition; to multiply by 3 was to add three numbers together. 'Multiplication' by $\frac{1}{2}$, however, is in no sense an addition, and the result is, in fact, to give a smaller number. This is, in essence, as paradoxical as the non-commutability of matrix multiplication.

N.Z. DEPARTMENT OF SCIENTIFIC RESEARCH

THE seventeenth annual report of the Department of Scientific and Industrial Research, New Zealand, covering the year 1941–42, includes the Minister's statement, the secretary's report, and reports of the various research committees of the Council, on research work at the agricultural colleges, on the work of the Dominion Laboratory, the Dominion Observatory, the Dominion Physical Laboratory, and the Geological Survey, as well as of the Magnetic Observatory, Christchurch.

The Department's activities have continued to be concentrated on problems arising out of the War, but both the Dominion Physical Laboratory and the Radio Development Laboratory have been established in improved buildings and provided with additional skilled staff to give greater assistance to the three Fighting Services and the munitions industry. Important defence scientific units have been established at the University of Otago, and at Auckland and at Canterbury University Colleges. The first commercial dehydration plants for butter, vegetables and meat came into operation during the year, and the plants are giving very satisfactory dried foodstuffs, largely because of the scientific effort put into their design and to previous testing on pilot plants by the staff of the Department. Investigations have been extended to examination of the raw materials used, their pre-treatment to conserve their food values and vitamin contents, and to their packaging in a form suitable to retain high quality when used as army rations by troops operating in difficult field conditions. Work on an up-to-date fruit dehydrating plant is well advanced.

Maps showing the soil types occurring in the North Island have been completed, and, based on these maps, others showing soils which will respond to lime treatment in different degrees have been prepared. A map of the areas suffering from erosion in the mountainous region of the South Island has been completed, and soil surveys have been made of three of the important linen flax districts of Otago. During the year a Building Research Committee was established by the Department which is giving consideration to the numerous problems which will arise and require investigation in connexion with materials necessary for the construction of houses after the War. The Department's activities have been closely associated with similar activities in Great Britain, in other Dominions, and in the United States of America.

The report of the Dairy Research Institute refers to continued work on problems designed to reduce the damage done through bacteriophage entry into both single strain and mixed strain starters used in cheese factories, as well as on the control of cheese mites, for which purpose ethyl bromide proved a satisfactory fumigant without detriment to the flavour of the treated cheese. Dried butter fat has also been produced. Under the Food Cold Storage Research Committee, work has continued on the refrigerated gas storage of apples, the effect of fertilizers on cold-storage quality, and on the orchard storage of apples. Other work under the Fruit Research Advisory Committee included long-term manurial investigations on apples, minor element studies and further successful trials with modifications of the normal spray programmes.

The Leather Research Association has commenced an investigation on the flexibility of sole leather. The Shoe Research Association has also been concerned with investigations on adhesives. The Cawthron Institute has continued investigations on the mineral content of pastures, while among the activities of the Mineral Resources Committee may be mentioned those on refractories and oil shale, and the preparation for publication of a full report on the geological survey of Chatham Island peat deposits and the chemical investigation of the wax. The Wool Manufacturers' Research Association has given much time to the introduction of the wet chlorine process of producing unshrinkable woollen garments, and to the examination of new unshrinkable processes, as well as to the influence of hairiness on processing.

Under the Plant Research Bureau the Agronomy Division has continued its investigations on linen flax, including the mite infestation of flax seed in store, for which purpose a dressing of 'Ceresan' has given good protection. The Botany Division, Wellington, has continued work on seaweed utilization, medicinal plants, rubber plants, and fibre plants. Good progress has been made during the year in the establishment of hard-wearing turfs for aerodromes, while the Plant Diseases Division has continued its work on vegetable diseases and pests, particularly the control of the carrot rust fly, late blight of tomatoes, and downy mildew of onions. Under the Timber Protection Research Committee the State Advances Corporation has continued field investigations of timber-infesting insects and fungi, the field application of termite control and the field application of wood-preservatives.

The report also includes a summary of the more important results emerging from the 1942–43 season's work of the Tobacco Research Advisory Committee. Entomological investigations at the Canterbury Agricultural College have included sheep-dipping experiments and work on insect pests of wheat and of cocksfoot. Animal production research has included studies of the nutritive value of New Zealand mutton and lamb, and the preparation of hormones. Work at the Wool Metrological Laboratory has been considerably curtailed, but the analysis of survey data collected during 1941–42 has been continued. The Massey Agricultural College has continued its experiments on sheep nutrition, drainage research, root development studies, and on sheep-breeding methods, as well as on pig research.

The report of the Dominion Physical Laboratory refers to investigations on pyrometric control, the chromium plating of gauges and tools, surface metallizing of mirrors, high-speed cross-bearings, measurement of low illumination, repair of lightning arresters, mould on wallboard, and on physical problems in the linen flax industry.

RESEARCHES ON PENICILLIN

So much has been written about penicillin, the bacteriostatic substance extracted from *Penicillium notatum*, that one hesitates to add more at a time when its properties, which are so remarkable that they seem to be almost magical, are still being investigated in Great Britain and elsewhere. It is clear that everything possible is being done to make this beneficent substance available in quantities as large as possible and to investigate to the full its possibilities.

E. Chain, H. W. Florey, M. A. Jennings and T. I Williams (*Brit. J. Exp. Path.*, 24, 108 ; 1943), working in Oxford, where already so much pioneer work on penicillin has been done, have continued the work of W. H. Wilkins and G. C. M. Harris (*Brit. J. Exp Path.*, 23, 166 ; 1943) and report the isolation in a crystalline state of helvolic acid, which, like penicillin is especially active against Gram-positive organisms and is chiefly bacteriostatic rather than bactericidal It is soluble in most organic solvents, but is insoluble in water, although its sodium salt is readily water soluble. Leucocytes are not affected by dilutions of it of more than 1 : 1,600 and tissue cultures can be exposed to dilutions of 1 : 2,500 for forty-eight hours It is excreted in the urine and bile. A high antibacterial titre can be maintained in the blood, but repeated injections of it damage the liver.

Another worker is briefly noted in the *Journal of the American Veterinary Medical Association* (102 385 ; 1943). The only reference given to the source of this note is that it is abstracted from *Science Digest* of an unstated date. The reference is to a substance which has been called 'penatin', discovered by W Kocholaty at the University of Pennsylvania. It is claimed that penatin has an even higher 'microbicidal power than penicillin (penicillin does not kill bacteria it inhibits their multiplication) and a wider range of application. It is claimed that "50 pathogenic and non-pathogenic species yielded to its action in dilutions as high as 1 : 400,000,000". Anthrax, diphtheria, typhoid, paratyphoid, brucellosis, pneumonia and pus-forming micro-organisms were 'killed' with dilutions of 1 : 12,500,000. Its action was not lowered in 90 per cent serum, and rabbits and guinea pigs suffered no obvious ill-effects from "large intravenous injections".

Readers who wish for further references to the properties of penicillin will find useful the article by M. E. Florey and H. W. Florey (*Lancet*, 387 ; March 27, 1943) on its general and local administration and the leading article in the *Lancet* (106 ; July 24, 1943 entitled "Penicillin in America". The latter article gives further references. J. Mackintosh and F. R

Selbie (*Lancet*, 793 ; June 26, 1943) compare the action of penicillin with that of some of the sulphonamides and compounds of the flavine type on anærobic infections of wounds, and a leading article in the *Lancet* (781 ; June 19, 1943) discusses the evaluation of wound antiseptics, with further reference to the literature of this subject. Sir Henry Dale, in his Frederick Price Lecture (*Brit. Med. J.*, 411 ; Oct. 2, 1943), briefly deals with penicillin and with the training, by cultural restriction, of a soil bacillus to produce gramicidin, which acts chiefly on Gram-positive cocci. It is clear that the Gram-positive organisms especially, and a good many others as well, are in for a pretty bad time in the years ahead.

Since this note was written the following important further articles on penicillin have appeared : "Progress with Penicillin" (*Lancet*, 546 ; Oct. 30, 1943) ; "Penicillin in the U.S.A." (*Brit. Med. J.*, 582 ; Nov. 6, 1943), both of which deal with American work, and the interesting paper by G. J. Harper (*Lancet*, 569 ; Nov. 6, 1943) on the destruction of penicillin by the penicillinase produced by certain bacteria.

WOOD UTILIZATION

THE Utilisation Branch of the Forest Research Institute at Dehra Dun, India, continues its issue of practical war research investigations in the Bulletin and Leaflet series of the Institution's publications. *Ind. For. Bulletin* No. 118 (For. Res. Inst., Dehra Dun, published 1943) discusses "Studies in Fire Resistance" of some Indian timbers. Experiments have been carried out on the rate of burning of fifty-two species of Indian timbers, and the influence of various factors like the structure of the wood, physical properties and so forth on the natural fire-resistance of wood is discussed by the writers of the bulletin, D. Narayanamurti and R. Gopalachari. In the present time when the public have come to regard iron and concrete as the chief materials in building construction, it may cause surprise to read the following recorded opinion of the investigators. It merits consideration and further investigation, when in Great Britain there is so much rebuilding and new building to be undertaken.

Wood, despite its many favourable properties, is held by many to be less valuable than iron or concrete because of its inflammability. Combustibility is not always the only criterion to be considered in a material of construction, and even when it is important careful investigation shows that wood behaves better than the other materials when exposed to fierce fires. Natural stones burst even on slight warming, and iron even at 500° C. loses half its strength. The loss of elasticity in heated iron leads to changes of form and shape so that sudden collapse without warning is unavoidable. With wood, in the early stages of fire, any small loss of strength due to the surface burning is compensated for by a loss in moisture content which increases its strength. Another defect of iron is its high thermal conductivity, which is more than two hundred times that of wood. For fire-fighting services also a wooden structure is less dangerous, and the clearing up of wooden wreckage is also easy. By proper methods of construction and suitable chemical treatment wood can be made very fire-resistant. The bulletin is written mainly for India; but the position of wood *vis-à-vis* iron and concrete is well worth a close consideration in the great building schemes facing Britain.

In *Ind. For. Leaflet* No. 42 (Res. Inst. Press, 1943) on "Preliminary Studies on Improved Wood", by D. Narayanamurti and Kartar Singh, the importance of wood from time immemorial for construction and fabrication is noted. 'Availability' and 'low cost' are two of the reasons given. In some parts of the world, however, neither of these statements is correct, notably in Britain. The leaflet discusses the results of experiments to improve the properties, in other words the resistance, of wood by impregnation with synthetic resins and other materials. Impregnation with resins is found to increase the density and compressive strength. Under suitable conditions it is possible to increase the compressive strength per unit specific gravity considerably—but attention is directed to the limitations of the process.

An *Indian Forest Leaflet* (No. 37 ; 1943), "How to Identify Timbers", Part 3, is a continuation of this subject. The author, K. A. Chowdhury, states that Part 1 of the series should be read in conjunction with the present one. The importance of the investigations dealt with in Part 3 lies in the fact that the timbers investigated in the Wood Technology Section have been those thought to be most suitable for motor-lorry bodies. It is well known that in the provision of equipment for the great armies in India that country has become inevitably more and more self-supporting. The leaflet gives a key for the field identification of important Indian timbers used for motor-lorry bodies. Short anatomical descriptions of these timbers have also been included. The importance of this type of information available to the local forest officer in the field is scarcely realizable to the layman. But anyone who has examined a great raft of logs consisting of the whole boles of the trees after floating down several hundred miles of a tropical river, with the object of identifying the botanical species of the logs, will have little difficulty in appraising the importance of this type of research.

PHYSIOLOGICAL BASIS OF CAMOUFLAGE

THE methods of camouflage and of reconnaissance in modern warfare are, to a great extent, conditioned, and even limited, by the potentialities of our visual and acoustic perceptions. Military experts are little acquainted with the scientific side of the problem of human senses and perceptions, while physiologists and psychologists have not yet paid sufficient attention to the application of their knowledge to the evaluation of the 'human factor' in war.

The recently created laboratory for the study of perceptions at the Institute of Psychology of the University of Moscow has, therefore, commenced the publication of a series of books and pamphlets on perception, observation, memory, emotions, etc., under war conditions, and the first booklet, by Prof. K. Kh. Kukcheev, deals with the psychophysiology of camouflage and of reconnaissance.

Detailed scientific data are given on such subjects as the sensitiveness of contrast vision ; stereoscopic vision ; estimation of distances ; perception of movement of different velocity ; colour vision ; visual perception at low light intensities in connexion with night reconnaissance ; physiology of sound perception ; sound 'camouflage' ; tactile perception and training for 'blind' action; olfactory perception and 'camouflage' of poison gases by other substances; etc. On every point, physiological facts and principles are briefly presented and illustrated by examples likely to be met on the battlefield.

The booklet is, apparently, not intended for immediate practical use; but rather to supply camouflage experts with the necessary data of physiological order.

FORTHCOMING EVENTS

(*Meetings marked with an asterisk * are open to the public*)

Saturday, November 20

BRITISH RHEOLOGISTS' CLUB (at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2), at 2 p.m.—Commander C. F. Goodeve, F.R.S.: "Rheology and Naval Problems".

Monday, November 22

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. W. A. Robertson: "Timber—the New Outlook" (Cantor Lectures, 1).

Tuesday, November 23

ROYAL ANTHROPOLOGICAL INSTITUTE (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 1.30 p.m.—Prof. F. C. Bartlett, F.R.S.: "Anthropology in Reconstruction".

INSTITUTION OF BRITISH AGRICULTURAL ENGINEERS (at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. S. S. McKay: "Mechanization in Farming".

ROYAL SOCIETY OF MEDICINE (at 1 Wimpole Street, London, W.1), at 4.15 p.m.—Discussion on "The State of Nutrition in Enemy-Occupied Europe" (to be opened by Colonel W. E. Vignal and Dr. A. P. Cawadias).

CHADWICK PUBLIC LECTURE (at St. Mary's Hospital Medical School, Norfolk Place, Praed Street, London, W.2), at 4.30 p.m.—Sir Harold Morris: "Sir Malcolm Morris, Dermatologist—Some Personal Reminiscences" (Malcolm Morris Memorial Lecture).*

INSTITUTION OF CIVIL ENGINEERS (at Great George Street, Westminster, London, S.W.1), at 5 p.m.—Mr. B. D. Richards: "Post-War Transport in Great Britain".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. J. C. Drummond: "Food Problems of the Post-War Years", 1: "Food Production".*

Wednesday, November 24

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. J. G. Davis: "Cheesemaking".

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. C. P. Edwards: "Enemy Airborne Radio Equipment" (with demonstration of equipment).

Thursday, November 25

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Prof. W. Perceval Yetts: "Links between Ancient China and the West: a Study of Exchanges in Material Culture", 1: "Roads to the West".*

INSTITUTE OF FUEL (in the Engineers' Club, Albert Square, Manchester), at 3 p.m.—Dr. E. W. Smith: "The Aims and Objects of the Institute in relation to the National Fuel Position".

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 3 p.m.—Dr. A. P. M. Fleming: Lecture to commemorate the Life and Work of Nikola Tesla (illustrated by examples of Tesla's experimental work).

BRITISH INSTITUTION OF RADIO ENGINEERS (LONDON SECTION) (at the Institution of Structural Engineers, 11 Upper Belgrave Street, London, S.W.1), at 6.30 p.m.—Mr. M. M. Levy: "Stabilizing Electronic Circuits".

Friday, November 26

PHYSICAL SOCIETY (in the Physics Department of the Imperial College, Imperial Institute Road, South Kensington, London, S.W.7), at 4.30 p.m.—Dr. H. T. Flint: "A Survey of Nuclear Field Theories".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—Sir Joseph Barcroft, F.R.S.: "The Preservation of Foods by Drying".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned;

ADVISER IN AGRICULTURAL CHEMISTRY—The Registrar, The University, Manchester 13 (November 23).

TECHNICAL ASSISTANT (second) in the Economics Department—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (November 24).

LECTURER (full-time) IN THE DEPARTMENT OF AERONAUTICAL ENGINEERING—The Registrar, Loughborough College, Loughborough, Leics. (November 27).

INSTRUCTOR (full-time) IN PLUMBING in the School of Building East Ham Technical College—The Secretary for Education, Educatio Office, Town Hall Annexe, Barking Road, East Ham, London, E. (November 27).

LECTURER (part-time) ON WORKS ORGANIZATION AND MANAGEMEN —The Principal, West Ham Municipal College, Romford Road, Stratford, London, E.15 (November 29).

CHIEF TECHNICAL OFFICER—The Secretary, Warwickshire Wa Agricultural Executive Committee, 6 Guy's Cliffe Avenue, Leamingto Spa (November 30).

PSYCHOLOGIST (with an Honours Degree in Psychology, experienc of testing, remedial teaching, and preferably child guidance work)—The Medical Superintendent, Central Mental Hospital, near Warwic (December 4).

DEMONSTRATOR (temporary, full-time) IN BIOLOGY—The Dean, St Bartholomew's Hospital Medical College, London, E.C.1 (December 7)

DEMONSTRATOR (man or woman) IN THE CHEMISTRY DEPARTMENT—The Warden and Secretary, London (Royal Free Hospital) School o Medicine for Women, 8 Hunter Street, Brunswick Square, London W.C.1 (December 10).

CITY ENGINEER AND SURVEYOR—The Town Clerk, Town Clerk' Office, St. Albans (endorsed 'City Engineer') (December 10).

FULL-TIME LECTURER (temporary) IN THE DEPARTMENT OF ELECTRICAL ENGINEERING—The Principal, Borough Polytechnic, Boroug Road, London, S.E.1.

LECTURER IN ELECTRICAL ENGINEERING—The Registrar, Merchan Venturers' Technical College, Bristol 1.

HYDROGRAPHICAL SURVEYORS for the Basrah Port Directorate Iraq—The Ministry of Labour and National Service, Appointment Department, Sardinia Street, Kingsway, London, W.C.2 (quotin Reference No. O.4962.S).

PROFESSOR OF PHYSICS, a PROFESSOR OF GEOLOGY AND MINERALOGY and a SENIOR LECTURER IN BIOCHEMISTRY, in the University of Melbourne—The Secretary, Universities Bureau of the British Empire c/o University College, Gower Street, London, W.C.1.

QUALIFIED METALLURGISTS for interesting work connected wit Powder Metallurgy—The Ministry of Labour and National Service Central (Technical and Scientific) Register, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. O.N.F.1212.X).

ASSISTANT MASTER (GRADUATE) FOR MATHEMATICS, SCIENCE AN DRAWING, in the Junior Technical School for Boys—The Director o Education, 8 Warrington Street, Ashton-under-Lyne, Lancs.

METALWORK INSTRUCTOR—The Principal, South Dorset Technica College, Newstead Road, Weymouth.

ASSISTANT IN THE BIOCHEMICAL DEPARTMENT—The Medical Superintendent, Dudley Road Hospital, Birmingham 18.

ASSISTANT METALLURGICAL CHEMIST for the Works Laboratory o an important Engineering Works near London engaged on highes priority Government work—The Ministry of Labour and Nationa Service, Central (Technical and Scientific) Register, Alexandra Hous Kingsway, London, W.C.2 (quoting Reference No. O.N.F.1669.X).

ENGINEER in the Directorate of War Production, Government o Palestine, and an ENGINEER in the Department of Heavy Industrie Government of Palestine—The Ministry of Labour and Nationa Service, Central (Technical and Scientific) Register, Alexandra Hous Kingsway, London, W.C.2 (quoting Reference No. E.804.A).

REPORTS and other PUBLICATION

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Experimental and Research Station, Nursery and Market Garde Industries' Development Society, Ltd. Twenty-eighth Annual Repor 1942. Pp. 78. (Cheshunt: Nursery and Market Garden Industrie Development Society, Ltd.) [71

Ministry of Fuel and Power. Twenty-first Annual Report of th Safety in Mines Research Board, 1942. Pp. 23. (London: H.M Stationery Office.) 1*s.* net. [131

Forward—by the Right! A Statement by the Tory Reform Committee. Pp. ii+16. (London: Tory Reform Committee.) [131

A List of 16 mm. Scientific Films including Mathematics, Physic Science and Biology. No. 14, revised. Pp. 36. (London: Briti Film Institute.) 2*s.* [181

Other Countries

South African Institute for Medical Research, Johannesbur Annual Report for the Year 1942. Pp. 51. (Johannesburg: Sout African Institute for Medical Research.) [21

Bulletin of the Geological Society of America. Vol. 54, Paper N 82: Meteorites and an Earth-Model. By Reginald A. Daly. Pp. 40 456. (New York: Geological Society of America.) [21

University of Cape Town. Communications from the School African Studies, New Series, No. 8: The Bored Stones of Souther Africa, Part 4: A. Cape of Good Hope; B. Elongated Types. B A. J. H. Goodwin. Pp. ii+24. (Cape Town: University of Ca Town.) 2*s.* [21

Lucknow University Studies. No. 17: The Cretaceous Rocks South India. By Prof. L. Rama Rao. Pp. v+81+3 plates. (Lucknow: Lucknow University.) [21

Indian Forest Leaflet. No. 42 (Utilisation): Preliminary Studi on Improved Wood. Part 1: A Study of the Impregnation of Woo with Resins. By D. Narayanamurti and Kartar Singh. Pp. 16. (Dehr Dun: Forest Research Institute.) 6 annas; 9*d.* [21

Indian Forest Records, New Series. Utilisation, Vol. 3, No. 3 Bamboo Nails, their Manufacture and Holding Power. By V. I Limaye. Pp. 12+3 plates. (Dehra Dun: Forest Research Institute 6 annas; 9*d.* [21

Catalogue

A Catalogue of Rare Books on Early Medicine and Surgery. (N 614.) Pp. 24. (London: Bernard Quaritch, Ltd.)

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PROBLEMS OF INTERNATIONAL MINERAL CONTROL

MANY of us, uplifted by the Atlantic Charter, may take that resounding slogan "equal access to raw materials" as a product of the modern democratic spirit. It would be well to recall, however, that it was used by the Germans during the War of 1914–18, and was repeated between wars by the Italians, the Japanese and others until it became the rallying call of the 'Have-nots'. We may first inquire as to how grievous was the inequality of access which the Axis Powers and the poorly endowed nations felt they suffered from, so far as mineral raw materials were concerned. Answers to this question and to a great many more in mineral politics are provided by a recent publication[1] of the Brookings Institution of Washington.

The uneven distribution of minerals—a distribution which cannot be altered—undoubtedly bore especially heavily on the Axis Powers. It has to be admitted that, apart from the coal, magnesite and potash of Germany, the bauxite, sulphur and mercury of Italy and the sulphur of Japan, little of the immense bulk and variety of mineral raw materials necessary for large-scale industry was available within their own borders. It may here be interpolated that their mineral position is not materially improved even with their boundaries temporarily inflated. Interchange of mineral products, as of other products, is accordingly unavoidable; no dictator, by taking any quantity of careful thought, can make his country self-sufficient in minerals—a fact brought home by the realization that even gigantic associations like the three chief 'mineral Haves', the British Empire, the U.S.A. and the U.S.S.R., are not themselves completely self-sufficient, either alone or in any possible combination.

To what degree, then, has equal access been denied to the 'Have-nots'? As the authors of "World Minerals and World Peace" demonstrate by maps and statistics, mineral raw materials have moved in gigantic quantities throughout the world. It has been the major preoccupation of most of the great mineral cartels and monopolies to find markets. Indeed, many of these associations were formed expressly to expand their mineral sales. The Axis Powers were invited, and even enticed and persuaded, to buy Canadian nickel, American oil, Russian manganese, Malayan tin, and so forth. To all who were able to pay, there was equality of access to buy. The price could not be the same to all buyers, any more than manufactured goods are available to all on an equal-cost basis; the cost of transportation, considerable with the majority of mineral products, controls this. Further, equality of access, as distinct from freedom of access, was affected to only a slight extent by the working of the many varieties of trade barriers. Export tariffs provided revenue for the exploiting country, import tariffs were designed to aid a home production. These controls, with quotas, embargoes and the whole fiscal kindred, gave rise to friction between combinations of consumers and producers, but not between the 'Haves' and the 'Have-nots' as such. The removal of all trade barriers which are deliberately designed to offset the inequalities of mineral distribution would, as pointed out by Leith, Furness and Lewis, emphasize these inequalities and would contribute little to the solution of the general problem. These investigators conclude that most of the complaints raised by the 'Have-nots' arise from the strategic importance of minerals in time of war. Modern war is primarily a mineral war, and the relative poverty of minerals of the Axis Powers is a severe handicap to a career of aggression.

However dubious its origin may have been, the slogan "equal access to raw materials" has now become respectable and legitimized by Clause IV of the Atlantic Charter. The United Nations "will endeavour, with due respect for their existing obligations, to further the enjoyment by all states, great and small, victor or vanquished, of access, on equal terms, to the trade and to the raw materials of the world which are needed for their economic prosperity". It will be recalled that the Division for the Social and International Relations of Science of the British Association held a conference on Mineral Resources and the Atlantic Charter in July of last year. Among the findings[2] of this conference were recommendations which led the Council of the Association to appoint a committee, under the chairmanship of Sir Thomas Holland, "to enquire into, and report upon, the state of knowledge of mineral and metal resources, other than coal and petroleum, essential for modern industrial development from the point of view of the Fourth Clause of the Atlantic Charter". The report of this Committee has now been published[3].

The major problem of the Committee was taken to be to suggest methods for obtaining and keeping up to date the essential facts concerning mineral resources. The imperfections of our knowledge of the distribution of mineral deposits and the shortcomings of the statistics of mineral production and trade are clearly serious obstacles in the attainment of reliable data. The estimation of mineral reserves, even in well-surveyed ore-bodies, is at most times a hazardous proceeding. This applies with particular force to the reserves in certain fields which, though important, are worked by primitive methods. The Committee makes a plea for the classification of ore-reserves according to the degree of certainty of knowledge of them, and requests that the grade and quality of the ore shall, where possible, be specified. A distinction, and that a just one, is drawn between what a mining company might consider to be mineral reserves, that is, economically extractable ore, and what a nation might consider to be mineral reserves, which would include such resources that may exist but have not yet been brought under estimation.

The domestic resources of the United States are surveyed in comprehensive fashion by the National Resources Board. It is to be expected that the U.S.S.R. has exact information on its mineral production and its mineral deficiencies. The Committee advises that a similar survey of the mineral resources and capacity for mineral and metal productions of the British Commonwealth should be undertaken.
is to be hoped, the Committee continues, that af
this War complete data on world mineral producti
will be available for an international organizati
through the activities of the various national resour
boards. It is recalled that a mass of information
mineral deposits is buried in the confidential reco
of mining companies, while details concerning t
activities of the greatest mineral company in t
world, the U.S.S.R., are not yet published. T
Committee urges, therefore, that, following
conspicuous example of the United States, each c
venient national unit should establish a minerals a
metals resources board to prepare a detailed asse
ment of its own resources, so that an internatio
resources organization may be completely inform
It is further urged that reliable statistics of the qu
tity and grade of minerals used in each national u
must be available so that "the quantity of r
materials necessary for the economic prosperity o
country" may be assessed.

Among its conclusions, the Committee consid
that "there is sufficient information already availa
to permit the framing of a general policy designed
regulate the flow of essential mineral supplies, fr
countries in which certain of them occur in excess
domestic requirements, to others which are defici
in the natural products required for their essen
peace-time industries". The framing of this gene
policy is unfortunately outside the terms of refere
of the Committee, but it would have been interesti
and perhaps entertaining, to have had some guid
lines from so distinguished a body. It is only fair
recall, however, that the equally distinguis
framers of the Atlantic Charter clearly foreshado
a policy of mineral control, but have unfortunat
given us no clue to their plan. Is a plan possible
even necessary ?

There can obviously be no sharing-out of min
deposits, nor can there be redistribution of colo
sources, nor can territorial adjustments be mor
correct if based upon a mineral plan. We have s
that it is the opinion of the authors of "W
Minerals and World Peace" that up to now there
been equality of access to buy for all who could
May not this very equality of access have been
root cause of the present troubles ? Equality
access is excellent for a concourse of peaceful nat
engaged in their lawful pursuits, though even
conflicting national needs may give rise to fricti
but equality of access has hitherto allowed though
aggressors to acquire and pile up stocks of
minerals in preparation for 'the day'. They h
moreover, been able to pay for them in many c
only by very questionable operations. This is
fundamental problem arising from Clause IV: s
it is clearly just that all nations should have e
and unrestricted access to minerals for peaceful e
by what devices can it be assured that minerals
not diverted to war-like purposes ? The furnish
of the 'reliable' statistics of each country's peace-t
requirements of minerals required by the Bri
Association Committee would, we may be sure,
little bother to a potential aggressor. There is

course, an excellent and infallible method of solving the problem, and that is to have no wars or, in other words, to prohibit armaments. Who will prohibit, and by what armament is the prohibition to be enforced ?

This matter of mineral control in relation to peace has engaged the attention of Prof. C. K. Leith of the University of Wisconsin ever since the War of 1914–18. Prof. Leith contributes a short final chapter on this topic to "World Minerals and World Peace". It is of interest to recall that plans for the allocation of the Allies' surplus mineral products among the defeated nations were prepared for the Paris Peace Conference ; their serious discussion was prevented, most tragically, by devotion to other and less worthy topics. Realizing that the sanctions against aggressor nations provided for in Article XVI in the Covenant of the League of Nations were much too comprehensive to be effective, Sir Thomas Holland proposed in 1929 his 'Mineral Sanction', whereby the export of mineral products to any country breaking the peace was prohibited. As we see it and with regard to this present conflict, a fairly complete mineral sanction is in operation ; the aggressors had, however, effected the obvious insurance—they had piled up enough spark-plugs to make sure that the tank would run for some time.

Leith is of the opinion that two primary requirements must be met to prevent stock-piling for war :

> "The *first* is that there must be preponderant possession of the world's mineral resources by those who elect to prevent would-be aggressors from storing up supplies.
>
> "The *second* is that machinery for the control of minerals must be in operation *prior* to the actual outbreak of war."

The mineral resources of the United Nations are at least three times as great as those of the Axis, and, with continued exploration, the factor will undoubtedly increase. The United Nations, therefore, *could* operate a mineral control. Such a control should be administered as a trust to ensure that minerals are allocated to nations in accordance with their needs for peaceful ends, and for these only. Its effective operation so that no stock-piling takes place would require supervision of various kinds—supervision of imports, supervision of uses, supervision of every phase of industrial activity. It would require also the closest co-operation between the countries producing minerals and an astounding lack of selfishness in nations and nationals. It would require, in other words, honesty among nations. Possibly some form of cartel for each mineral product, with an international governmental backing, might provide a reasonable middle course between complete nationalization or internationalization and the present structure of the mineral industry.

Leith, with the experience of the application of sanctions to Italy and of other episodes in the history of the League of Nations before him, pleads for planning *now*. He realizes, as the framers of the Atlantic Charter did not, that the use of force may be necessary for the working of any mineral control plan. Let us not confuse force with violence.

The greatest obstacles to the enjoyment of the natural wealth of the world by its owners, the people of the world, is that ancient and foul trinity which becomes more powerful with what we used to call progress—the trinity of ignorance, greed and fear. Physical planning with the head cannot remove the obstacles ; spiritual planning with the heart may, for, after all, most of them are simply the consequences of plain sin.

---

[1] Leith, C. K., Furness, J. W., and Lewis, Cleona, "World Minerals and World Peace" (The Brookings Institution, Washington, D.C., 1943).

[2] *The Advancement of Science*, No. 7 (1942).

[3] Mineral Resources and the Atlantic Charter : Report of the Mineral Resources Committee, *The Advancement of Science*, No. 8 (August 1943).

RECONSTRUCTION OF ENGINEERING EDUCATION

RECONSTRUCTION plans for many branches of national activity are under discussion, and it is of the greatest importance that every grade of education should be examined critically, since the influence of changes, whether for good or ill, will certainly be more far-reaching in this sphere than in any other.

It is therefore eminently right that professional bodies should give immediate attention to the education of future recruits to their professions, and the Council of the Institution of Mechanical Engineers is to be congratulated on the timely publication of its considered views on this important subject[1].

The Institution claims, rightly, that it has a national responsibility, by virtue of its charter, for the maintenance and enhancement of the standard of education of all grades of mechanical engineers, and in discharge of this obligation it has for some time been giving attention to educational problems. The publication of the White Paper by the Board of Education provided an appropriate occasion to place on record the major conclusions which have emerged from the Institution's discussions.

The Council of the Institution speaks with authority, and although, as is proper, its report specifically relates to problems connected with the training of mechanical engineers, it may be said at the outset that much of it is equally applicable to other branches of engineering. The report is comprehensive, and will repay close study by those interested in this vital question—which should include all who are concerned in any way with the future efficiency and professional status of the engineer.

It is impossible to deal here with all the topics considered and the questions raised by the Report but some of them, at least, may be appreciated if we attempt to trace the educational path of the young engineer of the future who desires a university training, after the reforms suggested have been implemented. At the age of sixteen, having made up his mind to become an engineer, he will be faced with the first decision ; whether to remain at school for another two years or to begin a works training. The answer may depend partly on economic considerations, but not so much as if he were living in the pre-war world, since there will be a well-considered plan of State bursaries to ensure that all suitable candidates can enter their chosen professions. Perhaps the determining factors will be his aptitude for study and his personal predilections. If he is anxious to start practical work at the earliest possible moment he will, for three years, follow an organized training in works and technical college, being released for part-time day-work in the latter; this period will include any national service to which he is liable. He will then, at the age of nineteen, be ready to enter the university, where he will find the matriculation requirements more consistent with his previous education and experience than they were for his predecessors. At this stage he will, perhaps, meet an old school-fellow who remained at school and obtained the Higher School Certificate, or its post-war counterpart. This school-fellow will have served a year in part-time instruction in works on a national service basis and will now also be ready to begin his academic career. Both of them are State bursars and are therefore not handicapped by accident of place of residence or by lack of private means from securing their education.

The choice of university will not be a matter even of such importance as it is to-day, since the diversities of practice in regard to courses and custom which now exist will have been largely eliminated; one difference in particular will vanish—wherever our young men study they will need an extra year if they are not content with pass degrees but desire to obtain honours. (In this connexion the Report is not quite clear whether the Higher School Certificate will exempt from the pre-intermediate year as at present, that is, whether the two will start level in their academic careers.) Their experience in works will have given them a certain critical faculty, and this will be exercised on the teachers and equipment provided for their instruction. These will be found to be above reproach. The teachers will be, and will remain, engineers who have been trained to teach and are 'refreshed' at intervals either by a return to industry for a period of three months in each year for several consecutive years, or in some cases for a complete year at a time. These teachers will be paid adequately, and their prospects will be comparable with those which would have been open to them if they had followed industrial careers. Not only will they be kept up to date in the practice of their profession, however, but by means of refresher courses at a postgraduate college they will be kept in touch with the newest scientific developments in particular subjects; they will, moreover, add to these developments by their own researches, for which time will be made available and, in addition, will assist local industry as consultants in their specialized subjects. Finally, they will be encouraged to take part in the various activities of the professional institutions, and this will indeed be part of their regular work, for which they will be entitled to recover expenses from their governing bodies. At intervals our young undergraduates will miss some of their accustomed teachers for a time as they will have exchanged posts temporarily with their opposite numbers in universities either in Great Britain or abroad.

The equipment of the laboratories will be representative of modern practice and will be kept up to date by industrial organizations and associations Here perhaps one may be allowed to express some doubt as to whether this proposal is the best possible or even to be advocated. It will readily be agreed by those who know the conditions of many engineering laboratories that the standard of equipment i often "deplorably low", as stated in the Report, bu it is doubtful whether in most cases general engineering machinery is suitable for instructional purposes Specially designed plant is usually necessary i essential principles are to be taught, even perhap at the expense of some lag behind latest industrial development. Doubt may also be expressed as to whether the "range of basic knowledge" is expanding quite as continuously as the Report suggests—applications certainly are doing so, but in teaching the undergraduate it may be wise to draw a distinction. Basic knowledge is the proper scope of undergraduate studies; special developments appear more properly in postgraduate courses.

During long vacations, students will be expected t spend at least eight weeks in gaining practical experience of one sort or another, and this will be arranged for them by their university co-operating with employers in industry.

In due course our students graduate and will then complete their practical training by spending sufficient time in works to bring the total period of work training up to not less than two years. If they wish to continue their academic work they can do so by spending one or two years in advanced study or in research, and the Report makes the suggestion tha students of one institution should be allowed to do this at another which has specialized in a particula field. This is already done in many instances, but the principle might well be extended, even to the extent of making the Ph.D. degree of one university available only to postgraduate students from others; this would be in close accord with the original intention behind the establishment of this degree.

In some respects the proposals are not seriously dissimilar from existing conditions in many universities, but they are very far from those which obtain in technical colleges, particularly as regards the conditions of employment of staff, teaching hours and encouragement of research. In this last connexion the Report in no way overstates the case when in commenting upon the adverse effect upon superannuation of time spent on work other than teaching it says "A more effective way of discouraging research would be difficult to imagine". It is the desire of the Institution that technical colleges, as well as universities, should conform to the standard suggested and it would like to see more full-time students in the technical colleges. It is stated tha there is room in industry for a greater number o men of graduate rank than can be supplied by th universities and that suitable technical college should provide to a greater extent than at present full-time courses of degree standard.

This is open to discussion; it may well be argue hat the work of the universities and the technical olleges should be differentiated, rather than identiied, and that they should be training men for ifferent kinds of equally important work. If that vere conceded, it might be necessary to extend to ome extent the facilities in the universities, but still more probably it would entail a substantial increase n the provision for training in technical colleges. At present there appears to be a tendency for the universities and the technical colleges to overlap unnecessarily, and it cannot be an economical or fficient use of resources when, in the same limited rea, a university grants its own degrees and one or more technical colleges prepare for degrees of another university. There is certainly enough work for all o do, but not necessarily of the same kind.

This article has concentrated on those sections of he Report which deal with the university training f engineers; many other important topics are xcluded by lack of space. Practical training, for raftsmen as well as professional engineers; courses n technical colleges for craftsmen; and the allocation f available funds for educational reconstruction; are lso discussed in the Report. On the last, a feeling of disquiet is expressed that the Board of Education laces undue emphasis on "Buildings" as the end of ll technical educational reform. It is to be hoped hat the powerful influence of the Institution of Mechanical Engineers will be reinforced by that of ther interested bodies to prevent this fear being ustified by the event.

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[1] The White Paper on Educational Reconstruction and its Impact n Training for Mechanical Engineering. (London: Institution of echanical Engineers, 1943.)

EDWARD TYSON, 1650–1708

dward Tyson, M.D., F.R.S., 1650-1708, and the Rise of Human and Comparative Anatomy in England

A Study in the History of Science. By Prof. M. F. shley Montagu. (Memoirs of the American Philoophical Society, Vol. 20.) Pp. xxix+488. (Philaelphia: American Philosophical Society, 1943.) dollars.

THE keynote of this book, as provided by Prof. Montagu himself, is an unbounded and emotional nthusiasm for its subject. Now enthusiasm may be good and a beautiful thing, but if the enthusiast ndulges in frequent and generous outbursts of it, his ision becomes blurred, and his opinions, to quote Mr. Sampson Brass, tend to verge upon the confines f injudiciousness. For example, Prof. Montagu entures to bracket Tyson with Copernicus, Vesalius nd Newton—a proceeding which the sober historian an regard only as a symptom of mental obscuration. Again, Tyson's competent but modest paper on the natomy of the rattlesnake is described as a study of reptile which has never been equalled before or ince; his anatomy of the opossum "has scarcely ver been excelled"; his demonstration of the relaions of apes and man (not even mentioned by Darwin) an "epoch-marking event" which "exercised a proound influence upon the intellectual development of he eighteenth century"; his research scheme is "one of the finest expositions of the method of comparative anatomy which has ever been written"; his description of the anatomy of the porpoise was such "as had not before been given by anyone of the anatomy of any animal", and so on. Such statements cannot be justified, and do not even enhance the importance of Tyson's genuine achievements, which could have been less picturesquely stated without detracting from their legitimate claims on our admiration. Prof. Montagu should take to heart the wholesome advice of De Quincey—not to sink over head and ears in love, but to leave afloat a trifle of brain to overlook the whole conduct of the affair.

To complete the ungrateful task of criticism, we must regret that Tyson's valuable contributions to comparative anatomy, published and unpublished, are not critically examined and assessed, in consequence of which the reader is not advised what exactly Tyson had discovered, and to what extent he had corrected and extended the labours of his predecessors and contemporaries. This task, therefore, has still to be accomplished. Even Tyson's well-known work on the chimpanzee is not adequately analysed from the *anatomical* point of view, although such an undertaking would have been well within Prof. Montagu's competence as a professor of anatomy.

The merit of this work, therefore, lies in what Prof. Montagu has to tell us of Tyson's life and cultural environment, and here he has much to say that is new and of undoubted value. This part of the monograph would have been even more impressive had not the War cut short his last visit to England before his researches were completed. This affected particularly the work on the Tyson manuscripts preserved in the Royal College of Physicians and the British Museum, which naturally can be studied only in those institutions. The records of the Royal Society include much Tyson material, of which Prof. Montagu has made the fullest use. As a craftsman Tyson cannot be compared with Casserius, Malpighi and Swammerdam; but his scheme for the promotion of a science of comparative anatomy, which he did not live to implement, shows that he had a more prophetic and philosophical outlook than his seventeenth-century contemporaries. Prof. Montagu is particularly admirable on this theme, as he is also in his essay on Tyson's remarkable monograph on a young chimpanzee, although here Tyson owed much to the assistance of Cowper, and in his other work to Waller. Not much is known of Tyson's life, but Prof. Montagu seems to have exhausted all possible sources, and it is therefore scarcely likely that we shall ever know more. His account of the history of the skeleton of Tyson's chimpanzee, now in its final resting-place in the British Museum, is particularly attractive. An extensive, and with few exceptions accurate, bibliography is appended.

Prof. Montagu appeals for corrections, and here are a few of the more relevant points which have been noticed in reading this original and important work. Pp. 50–1: Attention is here directed to an unusual bibliographical problem. Tyson has been credited with having published in 1669 a work on the *Rhymes* of the Ancients. This, as Montagu rightly points out, is a mistranscription of the *Pygmies* of the Ancients of 1699, but the mistake has been extensively repeated in various bibliographies. Montagu ascribes the error to Munk in 1878, and severely criticizes him for it. Who first started this bibliographical hare the present writer is not prepared to say, but it was certainly not

Munk, who simply copied it word for word from Watt's "Bibliotheca Britannica" of 1824. P. 58: Redi 1671. There is evidently some confusion here. The work by Redi is not correctly quoted or described, nor was it translated by Waller. P. 122: "Jan Jocoboz [Jacobsz.] Swammerdam" was Swammerdam's father. P. 137: Tyson's Faithorne was the father (1616–1691), not the son. Pp. 152–3: The tapeworm described by Tyson was *Taenia pisiformis* of the dog, of which he examined the external characters only, and, even so, unaccountably failed to observe the suckers of the scolex! He does *not* give us a minute and perfect description of the anatomy of the worm. The worm figured on p. 153 is obviously not a Bothriocephalid but a Taeniid—probably *Taenia saginata*. P. 161: *Rana piscatrix* is not a frog, but the fish *Lophius piscatorius*. P. 169: Tyson cannot be acquitted of the belief that the peccary had three stomachs. His language is unmistakable, and he even compares the three stomachs of the peccary with the single stomach of the common pig. Pp. 184 and 388: Tyson did *not* discover the cochineal fly. His figures represent one of the Coccinellid predators of that insect. P. 196: Hartmann recognized the animal nature of hydatids in 1685 before Tyson. P. 211 and also bibliography and index: Powers is the possessive case of Power. P. 283: The progressive diminution of the thymus during life was known to Galen. P. 327: Neither Tyson nor Hale discovered the human allantois, judging from Hale's paper. P. 357: Tyson's "yellow gurnard" was *Callionymus lyra*. P. 382: Perrault's philosophical views on comparative anatomy do not appear in the Parisian memoirs, but in his "Essais de Physique", and they compare very favourably with those expressed in Tyson's "Preliminary Discourse". P. 390: Grew (1675 and again in 1681) was the first to use the expression comparative anatomy in the title-page of a book. P. 408: In the Opera Omnia of Tyson, published in 1751, the unsold copies of the first and only edition of the anatomy of the Pygmie of 1699 were bound up with reprints of Tyson's other works. A comparison of the two "editions" of the Pygmie work shows that they are absolutely identical in every respect, and the relative scarcity of the 1751 edition is due to the small number of copies of the Pygmie which were available for this issue.

F. J. COLE.

ADVANCES IN BIOCHEMISTRY

Annual Review of Biochemistry

James Murray Luck, Editor; James H. C. Smith, Associate Editor. Vol. 12. Pp. ix+704. (Stanford University P.O., Calif.: Annual Review, Inc., 1943.) 5 dollars.

THIS, the twelfth volume of the "Annual Review of Biochemistry", is a remarkable production in that it shows so little evidence of war and all that war is meaning to the scientific worker. We need not recapitulate the difficulties which face the research worker; easy exchange of information and of publications is a thing of the past, and the censorship and import regulations have added greatly to the difficulty of our getting much-needed scientific books from the United States. In those many sections of scientific activity which make up biochemistry, the "Review" is more than ever useful in keeping us in touch.

The volume contains the usual articles on progres in what may be termed standard sections of th subject, but we would direct attention more partic larly to the sections in the latter half of the volum as examples of its utility. Experimental progres waits largely on an advance in technique such as afforded by the recent development of microchemic methods: it is affirmed that chemical behaviou remains essentially unchanged when only 10^{-8}–10^{-} gm. of matter is used. The section describing th developments in these methods is most helpful.

There is a report for the first time on the electro microscope, which has progressed rapidly since th building of the first compound instruments te years ago.

In the study of the biochemistry of micro-organisms there has been a striking shift in emphasi changing to the study of microbial nutrition fro that of metabolism. Many growth-factors have bee identified with typical vitamins, so that the result have a direct bearing on the nutrition of highe organisms. The report includes a summary of wor on anti-bacterial agents such as the sulphonamide and penicillin. Synthesis of vitamins by culture o Torula yeast on wood-sugar and other industri wastes has been known for some time, and such wor is being extended.

The demonstration that plant viruses are protei macro-molecules brought the chemist and the physici into this field. The review describes the formatio of acetyl and phenyl-ureido derivatives of tobacc mosaic virus and their inoculation into susceptib hosts. The experiments are thought to show tha infecting virus molecules may not necessarily func tion as exact patterns for reproduction, while a larg proportion of certain functional groups of the viru molecule may be changed without appreciably alte ing the virus activity. There is much work o tobacco mosaic virus, including the determination its constituent amino-acids.

No subject is more to the fore to-day than nutr tion, and there is a stimulating report on it. I Great Britain much is being done to persuade a co servative and ignorant public to eat the proper thing and there is a marked change for the better in gener health in consequence. The value of an improved die during pregnancy on the course of pregnancy, labou and convalescence of the mother and on the gener well-being of the baby is firmly established, an action has been taken to make it available her For the masses the lack of oranges and othe fresh fruits is a serious disability; the vitamins lo are only very partially made up from vegetable which are very hard to obtain fresh in the citie where they are most needed. Vegetables also a far too dear, almost beyond the purse of many, an it is a reflection on the Ministry of Food that whil recommending us to eat more vegetables we are n safeguarded against extortion.

Space restricts any more detailed reference to th other sections, though we may mention the stead but slow progress in the study of the proteins. Th is difficult and somewhat unfashionable work, b we are behind in our knowledge. In discussing t sugars, emphasis has been placed upon the effect unsaturation in directing and influencing not mere carbohydrate reactions but also biological reactio in general.

The editors and their helpers are to be congratulate on a most useful piece of work.

E. F. ARMSTRONG.

A Text-Book of Organic Chemistry

Historical, Structural and Economic. By Prof. John Read. (Bell's Natural Science Series.) Third edition. Pp. xiv+703. (London: G. Bell and Sons, Ltd., 1943.) 12*s.* 6*d.* net.

PROF. READ has taken advantage of yet another reprinting of his deservedly popular book to keep the subject-matter abreast of current advances. Although the operation had to be effected without upsetting the pagination, considerable ingenuity has been exercised in the successful execution of this delicate task. Without such restrictions the author would undoubtedly have made extensive alterations and additions, as a piecemeal revision of this type can never be entirely satisfactory. It is therefore not difficult for the reviewer to direct attention to a number of desirable additions and deletions, although t may be somewhat unfair in the circumstances. In particular, some mention of crotonaldehyde and the ethanolamines, both of which combine theoretical with industrial interest, might have been made; less emphasis could have been given to wood distillation as an industrial process, and the fact that a number of sex hormones have now been isolated and their tructures determined could have been noted. In view of recent developments in the United States, it s unfortunate that the expression "the nitroparaffins have little practical importance" should have been allowed to remain. It might be pointed out that vitamin A has now been obtained in crystalline form and that the vitamins of the B, E and K groups are sufficiently well characterized to deserve passing mention.

None of these omissions, however, detracts seriously from the unquestionable value of this fascinating reatment of organic chemistry. On the contrary, the useful revision of the sections on petroleum and the electronic theory of valency, the latter including some discussion of resonance concepts, the inclusion of a modern formula for a polysaccharide and references to sulphanilamide, *M* and *B* 693 and to the electrophoresis of proteins, to mention just a few points, combine effectively to bring this reprinting up to date.

E. R. H. JONES.

Intermediate Chemistry

By Prof. T. M. Lowry and A. C. Cavell. Third edition. Pp. xvi+876. (London: Macmillan and Co., Ltd., 1942.) 12*s.* 6*d.*

FIRST published in 1936, and revised in 1938, this excellent book has again been brought up to date y alterations in several important sections—in particular those dealing with carbon monoxide, the rusting of iron, the distillation of liquids, organic analysis, and the organic derivatives of ammonia. Many additional numerical problems have been provided, and improvements in the experimental sections—nearly two hundred of them—have been introduced.

Its purpose being "to provide a complete text-book f chemistry for Intermediate and Higher School ertificate examinations", the volume is accordingly ivided into six parts, headed, respectively, general nd theoretical, typical elements, transitional elements, analysis, physical chemistry, and principles of rganic chemistry. True, a candidate for one of these xaminations who had fully mastered its content ould be remarkably well prepared; but wise achers who tolerate examinations, and conscientious udents who utilize them, are likely to discern in this ery circumstance the real aim of the authors. This, quite evidently, is not merely to elongate any pass list, but to help to lay a solid foundation of accurate chemical knowledge and intelligent appreciation; a foundation which retains familiarity of design while providing truly adequate footings for the support of a necessarily weighty building in the modern fashion. Though described as an examination text-book, therefore, it is not a cram book. Indeed the authors, when discussing the habit of the individual trees, frequently direct attention to one or other aspect of the wood; and this serves to promote a balanced view and to maintain a sense of orderliness which contributes much to the reader's interest and holds his attention.

Chemical Industries

Edited by L. Ivanovszky. Eighteenth edition, largely rewritten and revised. Pp. xxiv+360. (London: Leonard Hill, Ltd., 1943.) 15*s.*

IT would be difficult to arrange the experimental sciences in an order that would tally with their relative importance in everyday life, but chemistry would undoubtedly occupy a very high place. Far away and long ago their applications played a very minor part; here and to-day they are almost indispensable. It is true that these applications relate very largely to the material side of our daily life, but unless we go forward with the march of civilization, look to increasing our wants as well as our needs, and extending our comforts, we shall fall behind as a progressive people and sink into the limbo of the 'have been'. These reflexions arise from a perusal of the latest edition of Leonard Hill's "Chemical Industries", which is replete with the information required by manufacturers, merchants, consumers, and by those numerous 'impure' chemists who traffic in the applications of their science to material human wants. This new edition is considerably larger than the old. The glossary of industrial chemicals has been increased by more than one half; the tables of physical and chemical constants have been revised and extended, and many new data concerning organic and inorganic compounds have been added. Further, entirely new subsections are incorporated dealing with metals and alloys, non-metallic materials, chemical plant and instruments, and the older ones on pharmaceuticals and perfumery raw materials have been replaced by new. Power plant, water-treatment, handling, conveying and transport are other sections of this very useful compilation.

E. H. T.

A System of Qualitative Inorganic Analysis

By Dr. J. L. B. Smith. Second edition. Pp. viii+64. (Cape Town, Bloemfontein and Port Elizabeth: Nasionale Pers Beperk, 1943.) 4*s.* 6*d.*

THIS work on qualitative analysis is intended purely as a laboratory manual, since the physico-chemical principles underlying analysis are not discussed and very little is said about the nature of the chemical reactions involved in the tests. These omissions, together with the use of a very large number of abbreviations, give the text rather a forbidding appearance, and the reader the impression that qualitative analysis is purely a mechanical operation of adding so much of one substance to so much of another. The book, however, contains some notable features which deserve consideration by students of advanced chemistry. Thus a systematic scheme has been worked out for the detection of all the common anions, and very precise details have been provided throughout for carrying out the tests under the right physical conditions. In choosing the tests the author has guarded, so far as possible, against the mutual interference of ions, and this is typical of the care he has taken throughout to ensure success to the user of his system of analysis.

A. C. C.

A Dictionary of the Fungi

By Dr. G. C. Ainsworth and Dr. G. R. Bisby. Pp. viii +360. (Kew: Imperial Mycological Institute, 1943.) 20*s*.

FOLLOWING the lines of Willis's well-known "Dictionary of Flowering Plants and Ferns", Ainsworth and Bisby have included in their 339 pages a mass of useful information. In addition to generic names, with a reference to the family and a brief note as to habitat, they have provided explanations of technical terms, though unfortunately without their derivations. Students with "little Latin and less Greek" may be puzzled, for example, to find under *plano-* both planogametes and planoconvex, even though the terms *plane* and *planetism* are defined in the preceding lines. Useful notes are given on some of the older mycologists, and such popular terms as *devil's snuffbox* are not disdained.

It is perhaps inevitable that, in a work of this kind, detail should be uneven. Thus under *sex* one learns that Pyronema—that classical fungus—has a trichogyne but not that it has an antheridium, though the non-motile sperms of the Laboulbeniaceæ are mentioned and both trichogyne and antheridium are illustrated in Fig. 54.

An interesting detail is that the book (apart from its appendix) is written in Basic English, but the simplicity which this suggests is lessened by the mass of technical terms. Comparatively few of those who look up the meaning of *metula* will be much wiser when informed that it is "a sporophore branch having phialides". It could be described nearly as briefly as "a branch bearing spores on flask-shaped outgrowths". The explanation of even superfluous technical terms may be of value, but their use is to be deprecated. Mycology is burdened with far too extensive a vocabulary, and the only serious criticism of this convenient little book is that it may revive words which were mercifully becoming obsolete.

Map Projections by Practical Construction

By A. Hinckley. Pp. 84. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., 1942.) 3*s*.

FOR students of limited mathematical ability, books on map projections usually have an arid and unattractive appearance. This little book—which assumes only an elementary knowledge of mathematics and provides simple practical constructions for a large number of projections, together with many exercises that bring out the value for many purposes of the study of the subject—is notably unusual in its treatment, and has the commendation of no less an authority than the secretary of the Royal Geographical Society. There is no doubt that the teacher of mathematics or geography—especially of the former—who is reasonably emancipated from examination limitations, will find in this book ample scope for much valuable work, and any student who follows it diligently will not only solve a large number of interesting mathematical problems but also acquire a considerable practical knowledge of the geographical applications of the study of map projections.

For the student of geography, who is primarily concerned with the selection of the most appropriate projection for any particular geographical purpose the book is, however, somewhat limited in being severely practical. Both teacher and student would appreciate a clear preliminary presentation of the problems involved in mapping the globe, and a systematic discussion of the relative value of different projections for different purposes, in addition to the incidental comments that are found in the book. At the same time it is recognized that the numerous excellent exercises cover a wide range of matters of interest and importance to the geographer.

L. S. S.

Simple Experiments in Biology

Compiled by Cyril Bibby. Pp. xii+164. (London and Toronto: William Heinemann, Ltd., 1943. 7*s*. 6*d*.

THE author of this useful book is education officer of the Central Council for Health Education, and joint editor of *Biology*. He is therefore very well acquainted with the practical needs of biology teachers, and the guidance they require. No specialized knowledge on the part of the teacher is assumed and no expensive apparatus for experiments is required.

The book is essentially practical; the theory being left to the more orthodox text-books. Descriptions are explicit, and the whole course is comprehensive The only criticism we have is that, although ther may be several reasons for not inserting an inde in this type of book, we still think its omission is t be deplored.

It is doubtful if there is any other book quite lik this, and we would strongly recommend its adoption in all classes of biology up to, and including, schoo certificate standard.

Hermaphroditos

The Human Intersex. By Dr. A. P. Cawadias. Pp ix+78+9 plates. (London: William Heinemann (Medical Books), Ltd., 1943.) 15*s*. net.

THE intersex or free martin has always been subject of great interest in medicine, in literature and in mythology. Dr. A. P. Cawadias develops his scheme of classification of androgynoids and gynandroids from a basic description of the physiolog of sex formation and of the physio-pathology of intersexuality. Case-histories and illustrations of th various types of abnormalities are given, and ther are some notes on the lines of treatment.

Studies on Immunisation

First Series. By Sir Almroth E. Wright. (Researche from the Inoculation Department, St. Mary's Hospital, London, W.2, Vol. 3.) Pp. xi+421. (London William Heinemann (Medical Books), Ltd., 1943. 25*s*. net.

THIS third volume in a series of the collected researches of Sir Almroth Wright contains reprints of papers on work done in the first decad of this century and originally published in 190 The survey covers the antibacterial elements of th blood fluids, agglutinins, bactericidins and opsonins and proceeds to vaccine and serum therapy.

POST-WAR NUTRITIONAL RELIEF IN EUROPE

THE English Group of the Nutrition Society discussed the "Scientific and Medical Aspects of Post-War Nutritional Relief" at a whole-day meeting held at the London School of Hygiene and Tropical Medicine on November 6. Lord Horder, who took the chair, remarked that the programme spoke of the scientific and medical aspects of the problem, not of the political, and he would endeavour to see that this intention was carried out. He sketched he contents of the official document setting forth the benefits which the United Nations Relief and Rehabilitation Administration (UNRRA) would confer on the nations whose representatives had subscribed to the document. Each of these nations is to be represented by one member on a Council which is o meet at least twice a year. In Lord Horder's opinion there is a gap in the machinery in the lack of a Supreme Economic Council to plan co-ordinated supply, and he thinks that the relation between the military administration of relief and the Relief and Rehabilitation Administration needs defining.

Conditions in Europe

Experiences of the War of 1914–18 and since, and the current state of nutrition in occupied Europe and elsewhere, were discussed by Prof. J. R. Marrack London Hospital and Committee for Co-ordination of Nutrition Surveys). During and after the War of 1914–18, the shortage of food was due much more o the neglect of agriculture than to the blockade. The total production of cereals in continental Europe was reduced by one third, and did not again reach the pre-war level until 1924. Livestock was reduced o 30 per cent in Poland, and the animals everywhere were very much underfed. The milk supply in Germany was 30 per cent of the pre-war amount. Freedom to trade was not restored to the ex-enemy and adjoining countries until April, and, in the case of Germany, until June 1919. Transport was hopelessly dislocated and local fighting still going on. Special machinery had to be set up or 160 million people would have been faced with great privation. All supplies provided by such special machinery were classed as relief and were almost entirely supplied by special credits, chiefly from the United States, or paid for in cash by the Governments of the recipient countries. Distribution was through the normal channels of trade, co-operatives or local authorities. Food was supplied in this way to twenty-one countries with a population of 230 millions, but relief was not continued after September 1919, except to children as canteen meals financed by charity.

The quantity of supplies imported into the countries other than the Western Allies and the neutrals was considerably less during 1919 and 1920 than during 1913, although food production was so much reduced. Only those children who showed signs of under-nourishment were fed, and these, at the peak periods in April 1920 and 1921, numbered, respectively, 3¼ and 2¾ millions. A large proportion also of adults must have needed more food and, though suffering was reduced by it, the relief sent was inadequate and stopped too soon.

Of the supplies sent, 60 per cent was flour and grain, though qualitatively, meat and milk were much more needed. The supplies sent for the children included food in unfamiliar forms which was often refused. The inadequacy of the relief is shown by the amounts of supplies to other countries. The total relief supplied in the five years, 1919–24, was less than the sum of imports of wheat and flour, meat, bacon, ham and sugar, into the United Kingdom in the one year, 1918. Similarly, the amount of pork products was less than one tenth of the total consumption of pork products in the United States in 1919. Only surplus products were sent as relief, regardless of their suitability, and, if food had continued to be rationed in Great Britain alone, far more would have been available for relief.

After the immediate post-war period, the Russian famine occurred in 1919–22, in which three million people died of starvation; this should be taken as a warning of what may occur if adequate preparation is not made. It is unfortunate that Dr. Melville Mackenzie has written of choosing which age-groups of the population should be fed and which left to die, as if this choice was inevitable and not a sign of failure.

When the present state of affairs is considered, the fact that food is rationed over most of the continent of Europe makes it possible to estimate that the average normal consumer is not getting more than 1,400 calories daily. The degree of deficiency varies from Greece, Poland and Spain, where the daily intake is less than 1,000 calories, to Germany, where it is about adequate. The deficiency of animal products is severe owing to slaughter of livestock. The effect of lack of food is seen in the increased death-rate from tuberculosis, which was a marked feature of the War of 1914–18 also. Some cases of famine œdema have been reported from Belgium. Rickets is said to be controlled by widespread distribution of vitamin D. The large amount of potatoes being grown should ward off scurvy. Fortification of the margarine with vitamins should prevent vitamin A deficiency if the supply of vitamin A holds out, but disruption of the transport of green vegetables may increase the risk. Use of flour containing a very large proportion of the whole grain should prevent gross deficiency of the vitamin B complex except in the maize-eating countries. This is the picture in Europe. From China we have little information, but the situation there may be the worst of all.

Surgeon-General K. Evang (Public Health Services, Norwegian Ministry of Social Welfare) stated that after the War of 1914–18 the most outstanding shortage was that of fats, the craving for which caused the greatest suffering. Rubner directed special attention to the effect of semi-starvation in causing mental deterioration, lethargy and indifference. In Denmark the exportation of butter caused the appearance of some hundreds of cases of blindness from vitamin A deficiency, but this only lasted until the blockade prevented the export of butter. It was very remarkable that the increase in the death-rate from tuberculosis, which was so marked in many parts of Europe, was in Vienna relatively greater among the better classes, because the deterioration in their food was relatively so much greater.

In the present War, production has not been so greatly reduced. The area dominated by the Germans is much larger and richer, and the Germans themselves are unlikely to suffer deprivation. Their food policy has not been the same in all countries; they have not looted them all and have even imported food into some.

The addition of 600 calories daily proposed as relief is not to be regarded as sufficient supplement to the average existing intake of 1,400 calories, though it can be used as a working basis. It is unfortunate that there is no criterion for the onset of a dangerous state of malnutrition except the returns of morbidity and mortality. The state of nutrition of political prisoners in the hands of the Gestapo must be very bad, since they are not treated as prisoners of war and may not receive parcels. There have been marked rises in the number of cases of poliomyelitis, cerebrospinal fever, erysipelas, diphtheria, pneumonia, scarlet fever, gastro-enteritis and scabies.

In practice, calories should be supplied first as grains and fats. Treatment should be just, as between the hungering nations; but justice should remember the differing peace-time standards of the various countries, and no country should be offered smaller rations than under the Germans. The supply of sea food in Norway could quickly be increased by a supply of new fishing equipment. All plans must be dominated by considerations of transport, production and the needs of economic warfare.

Dr. Geoffrey Bourne (University Laboratory of Physiology, Oxford) gave a sketch of the number of calories supplied as rations in the different countries in 1942. No attempt has been made by the Germans to feed the Russian civilians at all. The occurrence of anæmia and hunger œdema, and of deficiencies of vitamins C and D, calcium and riboflavin is anticipated.

Post-War Agricultural Production

Problems of production in relation to post-war nutritional relief were dealt with by Dr. J. Hammond (School of Agriculture, Cambridge, and Inter-allied Technical Advisory Committee on Agriculture). He pointed out that the manner of administration of relief will depend on whether countries are liberated separately, or together, and how far they have been destroyed. The shipping position will be of primary importance. The first phase must be based on supplying in all countries the minimum requirements needed for human life before any one country receives more. The rationing scale in Great Britain is taken as such a minimum basis. Five times as much land is needed to produce 1,000 calories of livestock products as of potatoes or bread; milk represents a more economical conversion from plant to animal products than meat does and should, therefore, have priority.

In supplying relief the production of the country concerned should be encouraged to the maximum extent and imports should supply the rest. Production of energy food must come first; in occupied Europe the actual production of crops has probably fallen by about 10 per cent, but that of livestock by 20–30 per cent. Relief should include a supply of agricultural machinery and fertilizers, so that production of potatoes, sugar beet and wheat or rye can be enhanced to the utmost; seed of suitable local varieties should be conserved for sowing. Crop production should have been restored to normal by the second harvest after liberation, but animal production will probably take eight years to re-establish fully, even if preference is given to female animals with artificial insemination from good bulls, and special veterinary care to raise health and fertility. Extra feeding stuffs should be provided by the offals from imported grains and, at a later stage, dairy cows might be imported from North America. Supplies of meat could be most rapidly increased by encouraging the rearing of pigs and poultry.

Of foods imported from abroad, cereals should come first where needed, and condensed and dried milks for mothers and children should have priority but there should also be early emphasis on meat and fats. If tropical oil seeds are imported whole, the residue could be used for feeding cattle. Meat, dehydrated to save shipping, should be imported for a considerable time to permit of livestock recovery.

The machinery to carry out the programme has been set up. The Allied Post-War Requirements Bureau in London has defined the requirements of each country, to be satisfied by the United Nations Relief and Rehabilitation Administration in co-operation with the Allied Military Government of Occupied Territory. The machinery for a longer-term policy was considered at Hot Springs. In Great Britain we have our part to play. Agriculture must, if anything, still further increase production, and we must anticipate a continuation for some time of rationing of anima products.

Miss Margaret Digby (Allied Post-war Requirements Bureau) stressed that the problem is one of applying limited resources to secure the maximum effect, but that we are more fortunate now than in 1920 because of the great progress in the organization of agriculture which has taken place both before and during the present War. The farmer now has confidence in the organization of agriculture, and managed production is thus made easier.

In liberated countries it will be necessary to change the machinery and type of rationing, which the enemy has imposed, to something more acceptable and to encourage production by a supply of desirable goods for which the foodstuffs produced can be exchanged rather than for a currency regarded with suspicion. The rise to higher nutritional levels will have to be gradual, and the feeding of people displaced and on the move will need special machinery Dr. P. L. Yates (Ministry of Economic Warfare mentioned that special inducements to farmers to produce might be offered on a points rationing system based on the amount produced. Production oversea must be further augmented. The surplus wheat would clearly now be insufficient, but it would be useless to offer surplus beans to people to whom beans are unfamiliar and unacceptable.

Nutritional Relief in the Field

The problem of the organization of nutritional relief in the field was discussed by Dr. Audrey Russell (Medical Director, International Commission for Wa Refugees). The problem is far beyond the scope of voluntary organization, but the experience gained by voluntary organization may be useful. Relief on the large scale should be through the ordinary channels of trade and the social services, and through whatever survives of the organization of local government It is through the social services, welfare centres and hospitals that opportunities for research may be found. Before any scheme can be started, a survey should be made of population, rations, local supplies markets and businesses, fuel, water supply, transpor and so forth, to be checked against official information. Bakehouses and bread constituents should receive special attention.

In Spain and France, the International Commission for War Refugees helped to supplement the rations of the static population by supplying weekly parcels of lentils, rice, sugar and tinned food to families in their own homes. They fed refugees on the road and in transit centres and semi-permanent camps and they provided extra milk and cereals for pregnant women and children and adolescents. For orphans and abandoned children, colonies were organized. Camps should not exceed 5,000 in number, and the ections should not include more than 1,000 each; each section should have an elected committee of 10, of whom one should sit on a central council. The ation cards for those receiving relief should register occupation as well as other details, so that appropriately trained persons can be summoned by loud-peaker to the vocation which is needed to help in he relief scheme; the people to be relieved are thus made as self-reliant as possible. In Catalonia, when he official ration in 1938 had fallen to 980 calories, he school-feeding scheme included provision of rest in the open for debilitated children while being taught at school. The children could thus live at home, so that it was not necessary to remove to a colony any but orphaned or abandoned children.

Prof. E. Nobel (formerly professor of children's diseases, University of Vienna) gave an account of the organization which was set up in May 1919, by Mr. Hoover on behalf of the U.S. Government, for feeding debilitated children in all lands. The freight charges were paid by the recipient countries. The ood was supplied cooked and was eaten on the spot. The children were selected according to bodily conition, regardless of race, creed or political opinion. Their bodily condition and nutritional needs were ssessed according to the Nem System of Prof. Pirquet.

Nutritional Research

Opportunities for nutritional research in the work of relief were indicated by Miss E. M. M. Hume (Lister Institute). The successful expedition to Vienna which Dr. Harriette Chick led for the Lister Institute and the Medical Research Council in 1919 roved that research in immediate post-war conditions can be made to yield valuable results; but this research should be only such as can be carried out nowhere else. The shape of post-war research will be the same now as then, but the tempo will have to be much quicker lest the research material is destroyed by relief; the first approach would be a scouting expedition.

At the end of the War of 1914–18 the Central Empires were completely ignorant of all the work on vitamins done in the English-speaking countries, so that ignorance reinforced the lack of food in promoting deficiency diseases. The first expedition to Vienna in 1919–20 was a reconnoitring expedition in which rickets, scurvy and adult rickets or hunger osteomalacia were investigated. The research was carried on throughout in close co-operation with the relief organizations, as should always be the case, and cases were found in hospitals, convents and sick benefit organizations. The relief missions were helped with advice.

Throughout the preliminary period an opening was being sought to make a planned crucial experiment in the occurrence of rickets in human infants. The opportunity was found at the University Kinderklinik, here Prof. Clemens von Pirquet had devised a system to suit famine conditions, by which infants were fed on a high proportion of carbohydrate and no vitamins. pproach was made to him through a distinguished neutral intermediary, Prof. Wenckebach, of Holland, and, with an extraordinary degree of international co-operation, Prof. Pirquet consented to allow this group of ex-enemy foreign women to carry out the experiment, which lasted from 1920 until 1922. The undertaking had the highest official backing from home, without which work in such conditions would at any time be impossible. Prof. Pirquet was inclined to believe that rickets was due to a low-grade infection but, when the contrary was proved, and rickets occurred and was then cured with cod liver oil, he acclaimed the result.

Although the investigation was so long drawn out, its shape was that of the preliminary reconnaissance in which alone observations or therapeutic trials could be made, followed by a planned experiment posing a special question and demanding the maintenance of negative controls. These main lines will remain the same to-day. Twenty years ago, the chief interest lay in the cure of florid deficiency states; to-day interest is greater in minor states of deficiency which may be utilized as criteria in assessing nutritional status, if their specificity can be established. This knowledge is especially needed for fixing the requirements of vitamins, to which there is a tendency at present to attach excessively high values. It should also be of the greatest help to those having the relief to do.

Whether the present War will offer any scope for the planned experiment, which demands the maintenance of negative controls, is uncertain. It is the possibility of legitimately obtaining negative controls for a human experiment which justifies the making of the experiment in such circumstances. There is not much likelihood that ignorance will provide the negative controls to-day, and it is to be hoped that insufficiency of relief will not do so either.

There are two rules which anyone trying to do such research should observe: to do only work which can be done nowhere else, and to remember that research workers are regarded as mainly a nuisance by the civil and military administrations.

Dr. A. P. Meiklejohn (Oxford Nutritional Survey) agreed that the first contact should be a reconnaissance, but a reconnaissance in force with mobile teams making rapid surveys of nutritional status by the various criteria nowadays recognized. Miss Hume disagreed with Dr. Meiklejohn as to the degree of reliability which can be attached to some of these criteria for assessing nutritional status; she believes that research should be directed to determining their reliability and specificity.

Summary

Lord Horder summed up the discussion. He admitted that it had not proved possible to keep the academic aspect of relief problems wholly distinct from the political. It was clear that the problem of supply could not be solved by mere transportation of surpluses. The problem is much deeper and more extensive than is commonly understood. Supply should be based on the minimum requirement as represented by current rations in the United Kingdom. He was of opinion that these should be reduced for some months in order to increase the supplies available for relief. The feeding of the Fighting Services might also be brought under review and some food thus released, and the extra protein ration for heavy workers might be cut for the same purpose. For research, new tools and new materials had been made available and, after the application of first aid, research should be there to help relief. AMGOT should be followed as quickly as possible by UNRRA, and hot on their heels should come "HUHO, Help Us to Help Ourselves".

COAGULATION OF COLLOIDS

By PROF. ERIC K. RIDEAL, M.B.E., F.R.S.

IN his presidential address delivered to the Chemistry Section of the Indian Science Congress last January, Prof. S. S. Joshi, of the Benares Hindu University, discussed *inter alia* various aspects of the kinetics of colloid systems.

In dealing with molecular reactions in solution, three methods of attack have yielded interesting and important results; one based upon gas kinetic concepts, the second on the Einstein diffusion equations and, finally, the transition state method of approach. In reactions between colloid particles or macromolecules, the second method of approach is generally employed and we are indebted to Smoluchowski for formulating the general principles.

The rates of coagulation are arbitrarily divided into rapid and slow rates respectively, the latter being derived from the former by the introduction of a factor ξ giving the fraction of collisions which are 'successful'. Since the rate of coagulation falls as particle charge rises, the potential barrier due to the diffuse layer of ions around the particles (the zeta potential ζ) can be regarded in the light of a potential barrier to be overcome for successful collision; we would thus anticipate that an equation of the type

$$\log \xi = \frac{K\zeta}{RT} + C$$

should connect the collision factor ξ with the zeta potential ζ. This is true for certain cases. We have found it to hold for quartz covered with gliadin, but in many cases the rate of coagulation is independent of ζ over a considerable range. Wiegner, Tuorila and Müller have shown that Smoluchowski's equations can be applied with considerable success to the problem of coagulation of uncharged particles, and extended the work to anisodimensional particles and more particularly to polydisperse systems. In the latter case it was shown that if the system were in motion the larger particles would 'strain out' the smaller ones. We might anticipate that the walls of the containing vessel would serve as collectors to neutral colloid particles undergoing auto-coagulation if the suspension was kept agitated. Prof. Joshi cites many cases of the effect of the containing vessel on the coagulation rates of sols, and makes the important observation that it is not necessary that the wall should have a zeta potential opposite in sign to that of the colloid.

Prof. Joshi rightly directs attention to the fact that the kinetics of coagulation do not obey the simple theory. The work of Levine in Great Britain and of the Amsterdam school of investigators has shown that for charged particles a position of minimum potential energy can be found in which the particles are a finite distance apart. We might thus expect to find doublets present in solution, which would require a definite energy of activation before they underwent true coagulation or coalescence; here the coagulation-rate would be pseudo-unimolecular. Another difficulty, which was first emphasized by Haber, is that the particles on coalescence undergo the phenomenon of 'ageing', resulting in a change of size and consequently a change in the diffusion coefficient on which the kinetics of coagulation are dependent. This ageing process, which can be followed in many cases by means of X-rays or by the rate of liberation of absorbed emanation or dyes, is virtually a process of recrystallization and proceeds mos rapidly in heteropolar systems such as colloida sodium chloride, and much more slowly in colloid such as the hydrous oxides or sulphides.

The most satisfactory method of determining th rate of coagulation of a colloidal solution is by direc observation with the aid of an ultra-microscope. Thi method is eminently suitable for colloidal system in which the refractive index of the disperse phas is markedly different from that of the dispersio medium; but where the light scattering is poor, a is the case for the proteins or hydrous oxides, man observational errors are apt to creep in. Man observers have consequently employed more indirec methods, especially the viscosity. The Benare school has made much use of refractivity measure ments for this purpose.

The utilization of viscosity measurements f following the rate of coagulation may be seriousl called in question. To a first approximation the vi cosity of a sol, if the electroviscous effect be eliminate by the addition of an electrolyte, should, in accor ance with Einstein's equation, be independent of th dispersity of the disperse phase, and only depend o its total volume. Prof. Joshi states that the viscositi of a number of dilute emulsions likewise obey tl Einstein equation. This can scarcely be the ca if the disperse phase has a measurable viscosity *per s* Prof. G. I. Taylor, some years ago, evaluated tl viscosity of a dilute emulsion in terms of the volun fractions and specific viscosities of the two phase but so far as I am aware, this equation has not bee subjected to any detailed experimental verificatio Changes in viscosity do, however, occur in coagulati of colloidal systems, partly because the speci volume of the disperse phase changes due to dehydr tion, partly because a shape factor begins to emer as the particles grow and, in some cases at leas as investigations on solutions of polymers have r vealed, the larger particles may be deformable und shear and thus raise the viscosity.

It is evident that many factors enter into t problem of the kinetics of coagulation and the determination, and we are indebted to Prof. Jos and his school at Benares for much painstaking a detailed work in this difficult experimental field. is satisfactory to note that real progress is bei made in that the factors operative are being isolat and identified.

ANGLO-PORTUGUESE SCIENTIF RELATIONS

By SIR GEORGE THOMSON, F.R.S.

IN view of the renewed intimacy which rece events have infused into the centuries-old associ tion of Portugal and Great Britain, and of the pro pect of increased co-operation between the tw countries, there is a special significance in t publication of a study in Portuguese by Prof. Amorim Ferreira on Anglo-Portuguese scienti relations*. The history of science is often treat as if it were a matter of a few great names, and o is apt not to realize the importance of the part play by those whose fame was greater in their life-ti than in after ages. In particular, problems of t transmission of ideas are often a matter of exploring the movements of the less well-known workers. This is a difficult and laborious task, but essential for an understanding of the spread of scientific knowledge and the birth of ideas by the cross-fertilization of two strains of thought. Prof. Ferreira has made a most successful and detailed essay on these lines, and one may hope that this book will inspire others to similar tasks.

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* Relações científicas entre Portugal e a Grã-Bretanha. Por Amorim Ferreira. Pp. viii+76. (Lisbon: Academia das Ciências Lisboa, 1943.)

Without question, the greatest contribution of Portugal to science was the long series of voyages of exploration brought about by the enthusiasm and drive of Prince Henry the Navigator, who was himself a most successful example of collaboration between the two countries, for his mother was an English princess. His work broke down the scientific lethargy of the Middle Ages by making it clear that the known, even on this earth, is only a fraction of the knowable, which after all is the first condition for a vigorous school of science. But, even leaving his work aside, the relations between the countries have been extensive and varied.

Early in the list in chronological order we meet a series of Portuguese physicians who went to England in the sixteenth and seventeenth centuries, taking with them the benefits of Moorish medical science. Some of them held positions of great importance at the court and elsewhere and their experiences were sometimes more exciting than pleasant. For example, Rodrigo Lopez, who came to England in 1559, had dealings with Leicester and Essex, became chief physician to the Queen, and helped to influence her o the expedition of 1589. The failure of this and the ill-will of Essex led to his being unjustly accused of an attempt to poison the Queen in the interests of Philip of Spain. He was imprisoned, tortured and inally executed, a cruel reward for excellent work among the poor in the wards of St. Bartholomew's Hospital.

Lopez was a Jew, as were many of the Portuguese in England at this time; and later, even well into he latter half of the eighteenth century, their position in Portugal was insecure. Religious and other persecution has played a great part in the pread of scientific knowledge at many periods of the world's history, and our age has had ample experience of this example of good coming from evil. The movement between England and Portugal was not all in one direction, for a number of English Jesuits, mostly mathematicians, went to Portugal in the seventeenth century and promoted the study f their subject in that country.

The Portuguese physicians introduced the use of Peruvian bark to England, and developed a preparation of it long known as "English Water". One of the greatest of them, Castro Sarmento (1691–1762), improved this and broke with the secrecy common at the time by publishing his method of preparing it. It is interesting to note that through him the observations of the Jesuit astronomers at Pekin were transmitted to the Royal Society, an early example f inter-continental scientific relations.

During the latter two thirds of the eighteenth century the relations between Portugal and the Royal Society were very close. A great many papers of Portuguese origin were published in the *Transactions*, nd a surprisingly large number of Portuguese were elected fellows, some resident in England but others ot. Among the former one of the most remarkable was Bento de Moura, a man of great mechanical enius who improved Savery's steam engine in a way which earned the praise of John Smeaton. He afterwards returned to Portugal and entered the Government service, but fell foul of the then all-powerful Marquis de Pombal, and was imprisoned for five years in a fortress, where he died in 1766. Several of the correspondents of the Royal Society at this period were priests, among them Father da Serva, who helped to found the Academia Real das Ciências at Lisbon.

Towards the end of the eighteenth century, a number of students were sent from Portugal to England and Scotland to study medicine, a reversal of the tide in the previous century. Rather surprisingly, their director of studies at the Embassy was shocked at the expensive tastes of the Edinburgh students of the period.

In the nineteenth century a number of British scientific men did important work on the natural history of Portugal, and one, David Sharpe, is regarded there as the founder of Portuguese palæontology. In one case at least they received magnificent recognition, Alfred Tait being made Baron de Soutelinho for his work on phylloxera.

The contacts between Britain and the Portuguese islands have for long been especially close, and besides visiting scientific men, a number of British residents in Madeira have made valuable contributions to the natural history of the island. In another field of activity it is interesting to read that the artificial harbour of Ponta Delgrada was designed by Sir John Rennie.

The present book, which is dedicated jointly to the Academia das Ciências and the Royal Society, belongs to a series of scientific and historical works sponsored by the Academy.

PATULIN

In a recent article[1] we referred to the remarkable bacteriostatic properties of the fungal products which have been called 'penicillin' and 'helvolic acid'. Penicillin has recently been discussed at a meeting of the Royal Society of Medicine, which is reported in the *British Medical Journal*[2] and in the *Lancet*[3]. The *British Medical Journal* devotes an annotation to it entitled "Penicillin in Tunisia". Readers who wish to know the results of trials of penicillin in North Africa and the Middle East, and also the results of other clinical trials, should consult these two articles. Helvolic acid, isolated from *Aspergillus fumigatus*, var. *Helvola*, is the subject of an annotation in the *Lancet*[4]. It is distinct from 'fumigacin', which was isolated from *Aspergillus fumigatus* by S. A. Waksman, E. S. Horning and E. L. Spencer[5]. To these must now be added 'patulin', isolated from *Penicillium patulum*. The chemical properties and use of this for the treatment of the common cold are described in the *Lancet*[6].

In Part 1 of this article Prof. H. Raistrick explains that for some years he and his colleagues have been studying, at the London School of Hygiene and Tropical Medicine, the metabolic products of the lower fungi. A large number of these metabolic products have been isolated in a pure form, the chemical constitution of some of them has been determined and some of them have been synthesized. Prof. Raistrick and his co-workers have studied the anti-bacterial properties of some of these substances and give references in this article to their work. Patulin is one of these. Its chemical name is anhydro-

3-hydroxymethylene-tetrahydro-γ-pyrone-2-carboxylic acid.

In Part 2 of the article Dr. J. H. Birkinshaw, Mr. A. Bracken, Dr. S. E. Michael and Prof. H. Raistrick describe in considerable detail the biochemical and chemical properties of patulin. Pure patulin is a colourless substance which crystallizes in compact prisms or plates. It has been isolated from two strains of *P. patulum*, one obtained from Holland and one obtained from condenser water.

In Part 3 of the article Dr. W. E. Gye describes how he received a sample of patulin from Prof. Raistrick for chemotherapeutic tests on cancer. Being in the second stage of a common cold, Dr. Gye douched his nasal passages with a watery solution of patulin. Within an hour his nasal passages were cleared; the douches were repeated twice with weaker solutions; a night of undisturbed sleep followed and next morning he was quite well and back at work. A later trial failed to cure the early stages of another cold, and Dr. Gye suggests that patulin may not act on the virus stage; the secondary stage of infection with Gram-positive and Gram-negative organisms was, however, completely prevented. Later he found that solutions of 1 : 20,000 of patulin were painless (the earlier solutions of at least 1 : 1,000 tried by Gye caused some pain) and colleagues and friends of Dr. Gye's tried these. One of them reported that patulin did not reduce the temperature nor shorten the duration of influenza; but it did prevent the nasal symptoms which often obscure the diagnosis of this disease. Only one of these volunteers reported no effect at all. The results obtained by the others suggested that trials under controlled conditions were warranted.

Part 4 of the article describes these trials, which were conducted on Naval personnel by Surgeon Commander W. A. Hopkins. Experimental work showed that patulin has bacteriostatic powers against a number of Gram-positive and Gram-negative aerobic organisms. Preliminary experiments have shown that it is also active against anaerobes. Commander Hopkins says that patulin differs from penicillin, gramicidin and citrinin in showing no selective differentiation between Gram-positive and Gram-negative organisms. It is very much less active than penicillin against Gram-positive organisms, but is more active than penicillin against Gram-negative ones. It is more active than penicillin against organisms of the coli-typhoid-salmonella group and against *Bact. dysenteriæ* Shiga. The *Lancet*, in its leading article entitled "Moulds and Colds"[7], points out that these comparisons are made against the impure preparations of penicillin available two years ago. Pus and serum do not affect its action. Solutions of 1 : 8,000 do not affect the phagocytic activity of leucocytes, although solutions of 1 : 2,000 inhibit it.

Patulin keeps well in a phosphate buffer at *p*H 6 and this was used for the trials. Patients in whom differential diagnosis between the common cold and influenza arose were excluded; only cases of acute or subacute rhinitis with or without pharyngitis, that is, cases of the ordinary common cold, were used. The commonest organisms found by swabbing the nasopharynx of the patients were *Strep. pneumoniæ*, *Micrococcus catarrhalis* and streptococci (alpha and beta). When solutions of patulin of from 1 : 5,000 to 1 : 20,000 were sprayed at intervals of four hours or so into the nose, or snuffed up from the hand or introduced by a pipette or gargled, 57 per cent of the patients recovered completely within forty-eight hours, while only 9·4 per cent o the controls recovered in this time. A large number were cured by the end of twenty-four hours. When five cases of influenza were treated with a 1 : 10,000 solution, the course of the disease was not influenced in any way. This confirms Gye's statement above. Some difficulty was experienced in assessing the results, because the common cold has few objective signs and the patient's statements are not always reliable. A statistical note on the results by Prof. Major Greenwood concludes the whole paper.

Commander Hopkins is wisely cautious about the conclusions to be drawn from his results. He says that the etiology of the common cold is not yet fully understood and that further extended trials are required before definite claims can be made for patulin. It would seem that extended trials on patients with pre-existing or concomitant sinusitis are especially needed, because, in some cases described by Commander Hopkins, after an apparent cure of a cold by patulin, severe sinusitis developed. The public interest in a cure for the common cold is naturally so keen that Commander Hopkins's caution is as necessary as the statement by Prof. Raistrick that patulin will not be released for general issue until further large-scale confirmatory trials have established its value and complete freedom from danger. Meanwhile the Therapeutic Research Corporation, which has helped both financially and technically in the work here described, is arranging for the manufacture of patulin in adequate quantities.

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[1] NATURE, 152, 604 (Nov. 20, 1943).

[2] *Brit. Med. J.*, 654 (Nov. 20, 1943).

[3] *Lancet*, 638 (Nov. 20, 1943).

[4] *Lancet*, 609 (Nov. 13, 1943).

[5] *J. Bact.*, 45, 233 (1943); *Science*, 96, 202 (1942).

[6] *Lancet*, 625 (Nov. 20, 1943).

[7] *Lancet*, 641 (Nov. 20, 1943).

OBITUARIES

Mr. E. H. Clifford

EDWARD HERBERT CLIFFORD, who died on Octobe 11, aged sixty-seven, was a distinguished mining engineer whose name will long be remembered by hi professional brethren. His career contained no spectacular incident to bring his name prominently before the general public, his *métier* being rather tha of a 'back-room' boy, who nevertheless left behind him a record of solid achievement which will remain a monument to his name so long as gold and copper mining is carried on in the Transvaal and the Rhodesias.

Born in 1876, he went to St. Paul's School and commenced his technical education in 1892 unde Sir Clement Le Neve Foster. Graduating as an associate of the Royal School of Mines in 1895, h spent a year at the Bergakademie, Freiberg, before going to South Africa. During his early years on the Witwatersrand he filled a number of junior post of a varied nature both on the surface and underground in different mines, thereby laying the foundation of the wide general knowledge he ultimately accumulated. In 1899 he obtained his first executiv appointment as chief surveyor at Langlaagte Deep which now forms part of the Crown Mines. During the South African War he enlisted in the Johannesburg Mounted Rifles and saw extensive active service in the Eastern Transvaal. On demobilization h returned to Langlaagte for a short time before being appointed chief surveyor to Rand Mines, Ltd. During 1907–11 he acted as assistant to the consultant engineer to the Eckstein Group and was given the highly responsible task of investigating and reporting on properties in various localities which were then considered 'outside' areas but are now recognized as extensions of the original Rand series. One of these was the Modder B Mine, of which he was appointed manager in September 1911 just as it came into production. The company paid its initial dividend the following year and has continued to pay annual dividends ever since. Modder B, at the time Mr. Clifford became manager, differed in many respects from the then operating mines of the Central Rand in that the gold-bearing conglomerate had a very flat angle of dip. Consequently methods of working and development differing materially from those in common use on the goldfield had to be devised. The record of the mine is an eloquent testimony to the skill and knowledge with which Mr. Clifford faced and successfully overcame the problems. . .

Clifford's technical ability was so widely recognized and his professional status so well established that in 1912 he was appointed consulting engineer in Johannesburg to the Central Mining and Investment Corporation, a position he held until 1923, with the exception of a period during the War of 1914–18, when he acted as chief technical adviser to the Mineral Resources Department of the Ministry of Munitions. While with the Central Mining Group he became nterested in the question of deep mining, which he foresaw would become a matter of vital importance to the Witwatersrand. He gave much time and thought to the problems of deep winding and ventilation which would thus arise and pressed his views strongly on his colleagues in regard to these matters.

His experience with the Ministry of Munitions in he War of 1914–18 was invaluable to Sir William Larke and his colleagues on the Non-Ferrous Metallic Ores Committee, which was formed in 1940 to advise he Minister of Supply on the possibility of supplies from home metal mines during the War. Nobody knew better than Mr. Clifford that ample labour, time, money and patience are required to open or re-open even the smallest mine, and that, unless steps were taken quickly, nothing of any value was likely o be produced in the immediate future. He also had strong views on the necessity for reviving home metal mining on a long-term basis, and at times expressed himself forcibly on the subject.

In 1919 he returned to South Africa for a few years and, after resigning his position with the Central Mining Corporation, spent some time visiting mines in various parts of the world.

In 1926 he was appointed consulting mining engineer to the British South Africa Company, and commenced what was probably the most productive part of his professional life. Though he held no post directly responsible for the development of the great Rhodesian Copper Mines, he visited Rhodesia on behalf of the chartered company every year, where his advice was eagerly sought by the local managements, and his informed reports of great value to his colleagues in London.

Mr. Clifford's eminence as a mining engineer was recognized by the members of his profession when he was elected president of the Institution of Mining and Metallurgy in 1941, a difficult task in a difficult time, which he carried out admirably. His devotion to the Royal School of Mines was proverbial and, however busy he might be, he was always ready to advise and assist young mining engineers. He went to great trouble to find ways and means of encouraging the right type of recruit to enter the profession. He was also a governor of the Imperial College of Science and Technology, being appointed as their representative by the Royal Commissioners for the Exhibition of 1851.

Yachting was his great hobby, and, whenever his many professional duties allowed him, he turned to the *Vigilant* for recreation. She was a Thames barge converted into a comfortable cruising yacht in which, assisted by his wife, formerly Miss Jane Leck of Johannesburg, he delighted to entertain his friends. Every year he attended the barge races, flying the winning pennant won by *Vigilant* many years ago. Many of the fitments he made himself, as he was both a skilled carpenter and metal worker.

J. A. S. RITSON.

WE regret to announce the following deaths:

Mr. Clive Cuthbertson, O.B.E., F.R.S., fellow of University College, London, on November 16, aged seventy-nine.

Sir Edward Poulton, F.R.S., formerly Hope professor of zoology in the University of Oxford, on November 20, aged eighty-seven.

NEWS and VIEWS

Economic and Technical Reconstruction in Europe

THE address on "Economic and Technical Reconstruction in Central Europe" delivered by F. Nemec, Minister of the Czechoslovak Government in London, at a meeting of the Association of Austrian Engineers, Chemists and Scientific Workers on July 12 not only pays a tribute to the work of the Inter-Allied Committee on post-war requirements. It also gives an outline of the plan which that Committee has already worked out to cover the requirements for the first ix months after the liberation of Europe. The Committee indeed forms an important and valuable basis for setting up the proposed United Nations Requirements and Rehabilitation Association. Mr. Nemec mphasized once more that the technique of executing and rendering speedy relief to the enemy-occupied territories leads naturally to the second task of economic rehabilitation, which is essential if the European nations and European civilization are to be saved.

The requirements of the 'master plan', Mr. Nemec indicated, are based, so far as foodstuffs are concerned, on British consumption, giving due consideration to variations in climate and to any unusually severe malnutrition as well as to differences in the general diet of the countries concerned. Animal and vegetable oils and fats are of particular importance, and a maximum consumption of 70 per cent of the prewar consumption has been accepted for the first six post-war months, for countries like Britain where the consumption is high, and smaller restrictions for countries with a normally lower consumption. The importance of a quick supply of fertilizers as an essential to a recovery of agriculture was stressed, and Mr. Nemec uttered a warning with regard to the timber and paper position. Requirements in respect of leather, skins and boots over the same six-month period have been calculated on the consumption under the British rationing scheme of 1941–42, and the British ration also forms the agreed basis in respect of imports of textiles. Careful attention has also been given in the plan to the consumption of crude oil and its by-products and of coal. Czechoslovakia expects to be once more in a position to export coal, of which Austria was formerly her best customer. Requirements of the non-ferrous metals, copper, lead and zinc will be great, and supplies of medicants, seeds, certain machinery such as locomotives and lorries, will be of primary importance.

Mr. Nemec said that the joint organization of the United Nations will operate on the basis of a pooling of all means of transport and unified management of the entire post-war European transport system for relief purposes. One of the basic assumptions of the Leith Ross Committee was that the aim must be the full employment of the nations concerned. Mr. Nemec referred briefly to the problems involved in the industrialization of South-Eastern Europe, in which Czechoslovakia might well help; and expressed the view that it is essential to organize import control of important raw materials now, by creating pools for the supply of essential kinds of goods for the post-war relief period and afterwards.

Twenty-One Years of Broadcasting

NOVEMBER 1943 sees the completion of twenty-one years of regular and authorized broadcasting in Great Britain, and the coming-of-age of the British Broadcasting Corporation—formerly a limited company with the same initial letters, the British Broadcasting Company, Ltd. The occasion was celebrated by a special programme on Sunday, November 14, during which Mr. John Snagge presented a series of B.B.C. reminiscences. On the following Wednesday, November 17, Mr. Stuart Hibberd, chief announcer of the B.B.C., read a paper before the Royal Society of Arts entitled "The Coming-of-Age of Broadcasting". The amazing developments which have been achieved during the growth of broadcasting in Great Britain have been due to the excellent team-work of everybody concerned—artists, programme organizers and engineers alike.

Mr. Hibberd stated that it was the general strike of 1926 which brought home to people the importance of broadcasting in a national emergency, and demonstrated the power of the spoken word. The technical achievements following that include the introduction of the Empire short-wave service in 1927, the broadcasting of the bells of Bethlehem in the Christmas programme of 1933, and of a programme by members of the Byrd Antarctic Expedition from their camp nearly 9,000 miles away in April 1934. These programmes record the attainment of successful collaboration with other organizations such as the Columbia Broadcasting System of America, while one of the greatest triumphs of the outside broadcasting organization was that of the coronation of King George VI, when the whole programme was maintained for six hours non-stop without using a studio at all. During the War, the European and overseas broadcasting services have been developed to the point at which day and night transmissions are no made almost continuously in no less than forty-fiv foreign languages. In his closing remarks, Mr Hibberd directed attention to the possibilities of th future; and among these was a plea for a post-wa university of the air, by means of which student could be placed in touch with the greatest authoritie on their subjects in the land.

Indian Association for the Cultivation of Scienc

THE annual report of the Indian Association fo the Cultivation of Science for the year 1942 include the presidential address of Sir U. N. Brahmachari the report of the Committee of Management and list of papers appearing during the year in the si issues of the *Indian Journal of Physics* and *Proceeding of the Indian Association for the Cultivation of Science* Sir U. N. Brahmachari, referring to the beginnings o the Association, quotes from the sketch of the origina scheme given by Mahendra Lal Sircar on December 1 1875, indicating that the founder had in mind a institution combining the scope, character and objec of the Royal Institution in London and the Britis Association for the Advancement of Science. D Sircar hoped to see it develop into an institutio where his countrymen, after finishing their universit education, would on their own account carry ou original research in the different branches of science When the scheme had reached maturity, anothe scheme for a technical institution was launched b the Indian League, and it was only after some controversy that a decision was reached not to amalgamate the schemes, and the Association was inaugurated on July 29, 1876.

Sir U. N. Brahmachari then discusses the future o the Indian Association, and refers to the proposal t create a new body of members to be called 'fellows in recognition of distinguished research work conducted by them. The number of life-members ha increased by 17 since 1942 and of ordinary member by 60. It was proposed to remove the Institute to place nearer a seat of scientific learning, to renovat the chemical laboratory and create a fellowship, an ultimately a professorship, in the name of Sir P. Ray. The Department of Chemistry proposes to tak up the study of some of the more important problem in industrial chemistry, and an approach to th Governments of India and Bengal, the Board Scientific and Industrial Research and the Rockefell Foundation might be desirable. In addition t research, however, it is proposed to undertake th propagation of science, for example, by means of series of lectures by men of the eminence of Sir J. Bose, Sir C. V. Raman, Dr. F. W. Aston and other as well as to continue the present arrangements f research by postgraduate students for the doctorat of various universities. The president also suggeste regular meetings for the discussion of scientific subjects by the research workers of the Association, an full co-operation with the University College Science, Calcutta, the Bose Institute and the scien departments of the Colleges affiliated to the Universit of Calcutta, as well as the Calcutta School of Tropic Medicine and the All India Institute of Hygiene.

Absenteeism among Women

EMERGENCY REPORT No. 4 of the Industrial Healt Research Board (H.M. Stationery Office, 1943. 2*d* gives a study of absenteeism among women for th period 1942. It is concerned with the amount an distribution of absenteeism among women rath than with the causes. Random samples of workers in factories were studied for periods of six weeks, at times of the year which were not affected by leave or annual holidays. The women worked on the three-shift system and the shifts were changed weekly. Analysis of the figures showed that, contrary to the general view, few women habitually lost one or more shifts each week, but a large majority were absent for varying lengths of time at irregular intervals. This suggests a study of the personal causes of absenteeism. Much of the absence was due to full-week absence and this was mainly due to sickness. Married women lost more time than single women, and they also tended to have more longer and fewer shorter absences than single women. Absenteeism was highest on Saturday, and was lowest on pay-day. A factory that employed a very large number of women, and which had grown very rapidly and was situated in an isolated position, had a higher absence rate than one of more stable development and more advantageously placed. On the average it was found that there was little difference in absenteeism between women who took up to one hour to reach the factory, but above that limit absenteeism increased with travelling time.

Bicentenary of Martin H. Klaproth (1743-1817)

BORN on December 1, 1743, a few months after Lavoisier, Martin Heinrich Klaproth was the foremost chemist in Germany, and it was largely due to him that his fellow-workers in Berlin adopted the new theories of the French chemists in place of the phlogiston theory of their countryman Stahl. Klaproth was born in the small town of Wernigerode, in Upper Saxony. He was educated first for the Church. He began his life's work as an assistant in a laboratory at Quedlinburg, where he spent seven years. After short periods passed in Hanover and Dantzig, he entered the service at Berlin of the elder Valentin Rose (1736–71), the grandfather of the well-known chemists, Heinrich and Gustav Rose. His employer's early death in 1771 led him to set up a laboratory of his own and he afterwards gained a high reputation for his numerous and accurate analyses of minerals. His researches were regarded as a pattern for the rising generation of chemists, and to him we owe much of the early known facts about zirconium, uranium, tellurium, cerium, titanium and beryllium. He also prepared a mineralogical system, and with Friedrich Benjamin Wolf published the first German chemical dictionary. He held various public appointments; in 1788 he was elected a member of the Berlin Academy of Sciences, and when the University of Berlin was founded in 1809 by Wilhelm Baron von Humboldt, Klaproth was given the chair of chemistry. As a member of the Academy, he had in 1792 repeated the most important experiments of Lavoisier, and it was this that contributed to the spread of the new theories. He kept active to the last and died in Berlin on January 1, 1817, at the age of seventy-three. His son, Heinrich Julius von Klaproth 1783–1835), was a distinguished Orientalist and raveller.

Science Class Lecture Cine-Films

A VERY successful film exhibiting the Brownian movement has recently been made in the Natural Philosophy Laboratory of the Royal Technical College, Glasgow, by Mr. Thomas S. Wylie, a former student of the College, in collaboration with Dr. Quintin Moore, of the Bacteriology Department. A dilute aqueous suspension of colloidal silver particles of order $50\ \mathrm{m}\mu$ (50×10^{-7} cm.) diameter was viewed with the aid of a 'Cardioid' ultra-microscopic condenser in conjunction with a microscopic combination magnifying about 1,200 times. The film was photographed through the eyepiece of the microscope. This is an excellent example of a really useful application of cine-photography to the experimental illustration of a science class lecture. In order that the students of a large class can observe individually the Brownian movement under the microscope, it is necessary to have the apparatus set up on many successive meetings of the class. With this film the whole class can observe the motions in a matter of three or four minutes. Mr. Wylie has also made an interesting film which, in a time of about ten minutes, shows the following surface tension experiments, some of which are difficult to set up and manipulate: (*a*) formation of a drop with the subsequent Plateau's spherule; (*b*) camphor movements on a clean water surface; (*c*) the beating 'mercury heart'; and (*d*) the difference in pressure in large and small bubbles.

Do All Statements Make Predictions?

IN the July issue of *Mind*, Mr. John Wisdom, under the title of "Other Minds (VII)", continues his lengthy philosophical dialogue dealing with our knowledge of other minds. In this episode his three interlocutors, Black, White and Gray, expound in that strange, obscure, slang-ridden, ungrammatical English which Mr. Wisdom affects, a theme which merits the attention of all interested in the problems of epistemology. The theme is simple: "what makes a statement objective also makes it predictive". It would be impossible in a few words to review the subtle analysis, the fine distinctions, which emerge from Mr. Wisdom's variations on this theme. Every kind of statement which might claim merely to report present fact and not to predict anything is brought to the bar and convicted of lurking predictiveness. The knowledge expressed in the statement "I am in pain" is finally admitted to be not predictive, but it is alleged to be a queer kind of knowledge because we cannot conceive what it would be to be wrong on such a matter. Again, speaking of statements such as "All men are mortal" the author says: "They become more really knowable, more necessarily true, the fewer future facts can make them fail, and they become quite knowable and quite necessarily true only when no future fact can make them fail". This is what America's greatest philosopher, Charles Sanders Peirce, said forty years ago. It has not ceased to be true, and Mr. Wisdom embroiders its expression with many illuminating subtleties of thought.

Some Old Letters of Astronomical Interest

IN an article entitled "An Eighteenth Century Correspondence" in the October issue of the *Observatory* (65, 92; 1943), Prof. H. C. Plummer reports on the contents of a collection of old letters received by Nathaniel Pigott and lately presented to the Royal Astronomical Society. Nathaniel (*c.* 1740–1804) was the father of Edward Pigott, who discovered the variability of η Aquilæ. He was himself greatly interested in astronomy, making observations of a partial eclipse of the sun in 1765 and of the transit of Venus in 1769. He was elected a fellow of the Royal Society in 1772, and spent five months in the Low Countries in survey work. Five years later he made his home at Frampton, Glamorgan, where he equipped a private observatory with a transit instrument by Sisson, a 6-ft. achromatic telescope by Dollond, and other instruments. He lived in the heyday of the professional instrument maker, and such men as Bird, Peter Dollond and Sisson figure among his correspondents in this collection. Distinguished members of the Paris Academy of Sciences, of which he was elected a corresponding member in 1776, also corresponded with him, and the collection includes letters from Lacaille, Messier, Le Monnier and others. Among English astronomers whose letters to Pigott are preserved, Maskelyne and Hornsby are perhaps best known. At present, of course, the question of printing the collection cannot be contemplated; but the Royal Astronomical Society intends to preserve the correspondence carefully until such time as a selection, at least, of the letters can be published.

Earthquakes Recorded during July and August

BETWEEN July 4 and 31 inclusive thirteen strong earthquakes were registered at Kew, the strongest being apparently on July 29. This came from an epicentre 6,770 km. distant bearing an azimuth 270° from Kew, and attaining at Kew an amplitude of 870 μ. Other strong shocks were on July 11, registered at 02h. 30m. 14s. U.T. with maximum amplitude 45 μ from 17,700 km., and on July 23 registered at 15h. 07m. 28s. U.T. with maximum amplitude 87 μ from 12,200 km. At Wellington, New Zealand, earthquakes registered on July 11 at *ca.* 02h. 12m. 37s. from an epicentre at lat. 33° S. long. 177° W., and on July 23 at 15h. 03m. 45s. from an epicentre distant *ca.* 66°. During July in New Zealand there were nine locally felt earthquakes, the greatest being on July 10 in upper Takaka with Mercalli scale strength IV, on July 23 at Masterton with Mercalli scale strength III, and on July 28 from Christchurch to Timaru with Mercalli scale strength III.

In August there were five strong earthquakes recorded at Kew and twenty at Toledo. Those in common were August 2, Kew 01h. 06m. 39s., Toledo 01h. 06m. 38s., distance from Kew 19,000 km. and from Toledo 19,300 km.; August 10, Kew 15h. 24m. 48s., distance 8,100 km.; Aug. 12, Kew 05h. 03m. 14s., Toledo 05h. 04m. 06s., distance from Kew 9,300 km. and from Toledo 11,180 km.; and August 13, Kew 07h. 47m. 05s., Toledo 07h. 45m. 29s., distance from Kew 6,200 km. and from Toledo 5,100 km. The United States Coast and Geodetic Survey has determined the epicentre of an earthquake on August 31, this being lat. 13½° N. long. 91½° W., which is in the Pacific Ocean just off the south-west coast of Guatemala in Central America. Time at origin was 16h. 10·5m.

The Night Sky in December

FULL moon occurs on Dec. 11d. 16h. 24m. U.T., and new moon on Dec. 27d. 15h. 23m. The following conjunctions with the moon take place: Dec. 11d. 00h., Mars 7° N.; Dec. 12d. 01h., Saturn 2° N.; Dec. 17d. 07h., Jupiter 0·8° S.; Dec. 23d. 19h., Venus 3° S.; Dec. 18d. 13h., Mercury 2° S. The following occultations of stars brighter than magnitude 6 take place: Dec. 4d. 18h. 09·5m., ψ Aqr. (*D*); Dec. 13d. 00h. 51·4m., ν Gem. (*D*); Dec. 13d. 02h 05·3m., ν Gem. (*R*); Dec. 24d. 06h. 19·2m., γ Lib (*D*). The times refer to Greenwich and *D* and *R* refer to disappearance and reappearance respectively Mercury sets 20 minutes after the sun at the beginning of the month, and about an hour later than the sun in the middle of the month. It attains its greatest easterly elongation on Dec. 23 and on Dec. 30 i stationary. At the end of the month Mercury sets a 17h. 15m. Venus, a morning star, rises at 3h. 22m. 3h. 53m. and 4h. 34m. at the beginning, middle and end of the month respectively. Mars, in the constellation of Taurus, can be seen through most o the night, rising early in the evening and setting in the morning at 8h. 36m., 7h. 11m. and 5h. 49m. at the beginning, middle and end of the month The planet is in opposition on Dec. 5. Jupiter, in the constellation of Leo, can be seen late at night, rising at 22h. 11m., 21h. 17m., and 20h. 12m. at the beginning, middle and end of the month respectively Saturn is near Mars but sets later in the morning In addition to the above phenomena, Jupiter will be occulted by the moon on Dec. 17d. 07h. 18·6m., reappearing at 8h. 14·9m.. Winter solstice commences on Dec. 22d. 17h. The Geminid meteors are active during Dec. 1–12, emanating from different radiants in the constellation of Geminus.

Announcements

LIEUT.-COLONEL EDGAR PAM, consulting engineer to, and deputy delegate director of, the Mond Nicke Company, Ltd., has been elected president of the Institution of Mining and Metallurgy for the session 1944–45.

THE Institution of Mechanical Engineers announces that, thanks to arrangements made by the War Organisation of the British Red Cross and the Order of St. John of Jerusalem, 37 candidates recently sat for the Institution's examinations in prisoner of-war camps in Germany. No fewer than 3 (92 per cent) passed with an exceptionally high average percentage marking. The results reflect credit both on the candidates and on members o the Institution and others in the camps who organized classes and acted as instructors.

THE following appointments have been made in the Colonial Service: D. J. Cowan to be agricultura officer, Uganda; A. Storrar to be agricultural officer Kenya; T. P. Weldon to be agricultural officer Sierra Leone; M. J. Fitzpatrick to be veterinary research officer, Kenya; G. Q. Fowler to be veterinary officer, Nyasaland; P. D. L. Guilbride to be veterinary officer, Northern Rhodesia; G. W. G. Briggs (agricultural officer, Nigeria) to be senior agricultura officer, Nigeria; J. W. Wallace (agricultural officer Nigeria) to be senior agricultural officer, Nigeria F. S. Collier (senior assistant conservator of forests Nigeria) to be conservator of forests, Nigeria.

DR. J. D. ROLLESTON writes: Dr. John Fulton has directed my attention to an error in my obituary of Dr. A. C. Klebs in NATURE of September 4, p. 269 The bibliography of Harvey Cushing was prepared by the Harvey Cushing Society, not by Klebs. Dr Fulton was the compiler, but the work was principally done by Louise Eisenhardt and Miss Madeline Stanton, Dr. Cushing's former secretary.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Molecular Weight of Native Cellulose

THE molecular weight of cellulose is of great interest to cellulose chemistry, and many attempts have been made to determine it. The cellulose derivatives, esters and ethers, can in general be dissolved in simple organic solvents, and their molecular weights determined by the osmotic pressure method. It is questionable, however, if the derivatives can be prepared without degradation of the cellulose molecule. Therefore the study of cellulose in cuprammonium solutions is of very great interest. It has never been possible to carry out osmotic measurements of these solutions, owing to their high vapour pressure and the difficulties of membrane materials. Staudinger[1] has extrapolated his 'viscosity rule' from measurements of relatively low molecular weight materials and obtained degrees of polymerization of 2,000–3,000 for native cotton and ramie. Sedimentation equilibrium measurements were performed by Kraemer[2], who obtained values up to 1,300 for purified cotton linters, and estimated the molecular weight of native cellulose to be at least 570,000 (D.P. 3,500). Later, Mosimann[3] showed that sedimentation equilibrium experiments with filament molecules (nitrocelluloses) of very high molecular weights give doubtful results owing to swelling-pressure effects.

We have measured the sedimentation and diffusion velocities of different celluloses in cuprammonium solution. The complexity of the solution and the thread-like shape of the cellulose molecules make the measurements difficult. In order to achieve reliable results it is necessary to extrapolate sedimentation and diffusion measurements to zero concentration of cellulose. Both sedimentation and diffusion of these highly asymmetrical molecules are strongly affected by concentration. On dilution, the sedimentation velocity increases and the diffusion velocity decreases. The sedimentation velocity at free sedimentation (zero concentration) may be graphically extrapolated. By experience it has been found that the concentration function obeys approximately the formula

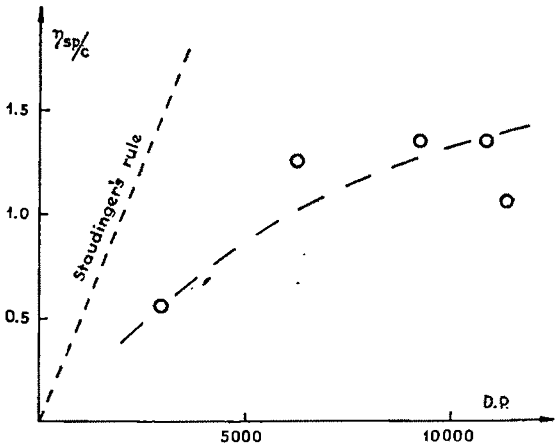
$$s = \frac{s_0}{1 + kc},$$

where s is the sedimentation constant determined at the concentration c, k is a constant and s_0 is the sedimentation constant at complete dilution. The diffusion constant at zero concentration may be determined from a single experiment by using the Boltzmann equation[4]. The diffusion constant has been found to be almost linearly dependent on concentration.

For calculation of molecular weights the formula

$$M = \frac{RTs}{D(1 - V\rho)}$$

(Svedberg[5]) has been used. This formula is independent of the shape of the molecules. The partial specific volume V of cellulose in cuprammonium solution was determined by Stamm[6] to be 0·642. Refractive index measurements have made it very probable that one copper atom is bound to every glucose unit. The cellulose copper complex has a lower specific volume than pure cellulose, and by taking the copper ion radius into consideration it was calculated to be 0·485.



All experiments were performed in a purified nitrogen atmosphere, and special arrangements were made for complete exclusion of air when filling centrifuge and diffusion cells. The results for different celluloses are given in the accompanying table.

Cellulose	$s_{c=0}$	$D_{c=0}$	M (cellulose)	*D.P.*
Unbleached cotton linters	10·7	0·23	$1\cdot50 \times 10^6$	9,200
Raw Georgia cotton	10·4	0·33	1·00	6,200
Nettle fibre cellulose	13·7	0·25	1·76	10,800
Ramie	10·3	0·18	1·84	11,300
Sulphite wood pulp	6·2	0·43	0·46	2,900

The sedimentation constants are given in Svedberg units (10^{-13} cm./sec. dyne), the diffusion constants in units of 10^{-7} cm.^{2}/sec.

It will be noticed that the molecular weights reported here are appreciably higher than those earlier reported for cellulose. For comparison, viscosity measurements were made. The results are given in the accompanying diagram. From this it is obvious that our results do not correspond to Staudinger's hypothesis of a linear relation between relative viscosity and molecular weight. At least for these giant molecules, the molecular weight increases very much faster than viscosity. From the sedimentation data it can also be deduced that the longer the molecules are, the more do they tend to become curled.

The free native celluloses in seed hairs and bast fibres have larger molecules than the prepared wood pulp. If wood is treated directly with cuprammonium, some of the cellulose goes into solution, and its sedimentation constant is about 8, suggesting a *D.P.* about 5,000.

The investigations are in progress, and full details will be published elsewhere. Financial support has been received from the Royal Swedish Institute for Engineering Research, the Rockefeller Foundation and the Wallenberg Foundation.

NILS GRALÉN.
THE SVEDBERG.

Institute of Physical Chemistry,
University of Uppsala.
Sept. 11.

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[1] Staudinger and Feuerstein, *Ann. Chem.*, **526**, 72 (1936).

[2] Kraemer, *Ind. Eng. Chem.*, **30**, 1200 (1938).

[3] Mosimann, *Helv. Chim. Acta*, **26**, 369 (1943).

[4] Boltzmann, *Ann. Phys.*, **53**, 959 (1894).

[5] Svedberg and Pedersen, "The Ultracentrifuge" (Oxford, 1940).

[6] Stamm, *J. Amer. Chem. Soc.*, **52**, 3047 (1930).

Decomposition of Hydrogen Peroxide by Catalase

WE have postulated previously that the catalytic decomposition by catalase of hydrogen peroxide to molecular oxygen and water is accompanied by changes in the valency of catalase iron[1]. This supposition is strongly supported by spectroscopic and manometric experiments carried out on azide-catalase. As additional evidence in support of this view, we brought forward the results of experiments carried out in Barcroft differential manometers, showing that under certain conditions even the activity of free catalase is inhibited when oxygen is completely removed from the surrounding medium and replaced by pure nitrogen. Our manometric experiments were repeated by Weiss and Weil-Malherbe[2] who, using Warburg manometers, failed to obtain this inhibition. Johnson and van Schouvenburg[3] also failed to confirm our results using luminescent bacteria as indicators of decomposition of hydrogen peroxide by catalase in complete absence of oxygen. However, we repeated our experiments from time to time, using different enzyme preparations, and invariably confirmed our previous results. The failure by other workers to obtain similar inhibition was explained by us[4,5] as being due probably either to some difficulty in complete elimination of oxygen from Warburg manometers or to some defects in their enzyme preparations.

However, two considerations induced us to reinvestigate the whole problem: (1) the ease with which our experiments were confirmed in our laboratory by Dr. H. Laser, who used for this purpose ordinary Warburg manometers; and (2) a private communication from Dr. Dickens informing us that he was completely satisfied with the experiments by Weiss and Weil-Malherbe carried out in his laboratory.

After a careful analysis of every step of our manipulation, special attention was paid to the nitrogen used in our experiments, with the view of detecting in it some impurities which could be responsible for the effects we invariably obtained.

The nitrogen in our experiments was purified by passage through a combustion tube filled with wire-form copper oxide reduced *in situ* with hydrogen and heated to redness in an electric furnace. The view that our purified nitrogen contained traces of impurities such as oxides of nitrogen was confirmed in various ways which can be summarized as follows:

(1) Incubation of a very dilute enzyme preparation with nitrogen purified as shown above, followed by evacuation and refilling the Barcroft manometers with air before mixing the enzyme with peroxide, already had a strong inhibitory effect upon the enzyme.

(2) The nitrogen from the furnace bubbled through sulphanilic acid – α-naphthylamine reagent at the rate of 100 ml. per minute for 20 minutes, together with a stream of oxygen, gave a positive colour reaction corresponding to 2 μgm. sodium nitrite.

(3) We have shown previously[6] that catalase combines with nitric oxide forming a well-defined compound.

(4) Decomposition of hydrogen peroxide in air by catalase is strongly inhibited by sodium nitrite in a concentration about ten times higher than those which could be detected in our experimental flasks, assuming that, in these flasks, 100 ml. of nitrogen comes into contact with our dilute enzyme preparations. On the other hand, the diazo reaction may be incomplete under these conditions.

(5) At the conclusion of all experiments in which inhibition was obtained, the liquid in the flask gave a positive brucine test for $-NO_3$.

(6) Passing the purified nitrogen to the manometers via a charcoal trap completely abolished the inhibitory effect of nitrogen.

(7) On lowering the temperature of the furnace so that within the combustion tube it reached only 400° C. and near the outlet somewhat lower, the inhibitory effect due to nitrogen together with the reaction for the oxides of nitrogen were completely abolished.

These experiments clearly demonstrate that the inhibition of catalase activity ascribed previously to the absence of oxygen was due to traces of some oxides of nitrogen formed during the purification of nitrogen owing to the high temperature of the furnace. It is interesting to note that out of many enzymes tested with this 'purified' nitrogen, so far only catalase, perhaps on account of high dilutions, seems to be affected by such minute traces of impurities. These results, as will be shown separately, do not invalidate our view that the catalytic decomposition of hydrogen peroxide by catalase is accompanied by reversible changes in the valency of its iron; a view shared by several other workers[7,8,9]. They only show that conditions have not yet been found for the detection of the ferrous state of free catalase during its activity owing to its much too rapid re-oxidation.

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Mechanism of the Butanol-Acetone Fermentation

THE mechanism of sugar breakdown in alcoholic fermentation by yeast, lactic acid fermentation by lactic acid bacteria and glycolysis by animal tissue has been elucidated, but the intermediate steps of the butanol-acetone fermentation are not yet known. The main problem, the transformation of C_6-compound into C_4-compounds (like butyric acid or butanol), ha not yet been solved. Two facts indicate that thi fermentation follows a different scheme: (1) the normal C_3-compounds, which are doubtlessly intermediate products in the other fermentations, do *no* yield C_4-compounds; (2) *pentoses* cannot be fermented by yeast whereas they are fermented by action of butyric organisms to the *same* C_4 products as are obtained starting with C_6-compounds. As method of approach to this problem a systematic research on the *structural conditions of the substrate molecule* leading to C_4-compounds through the bacterial enzyme has been carried out in continuation of previous experiments[1].

All experiments were made with a strain of *Clostridium acetobutylicum* (Weizmann). The same results were obtained with fresh bacteria (centrifuged after 24 hr., fermentation in 1 per cent maize mash, washed three times with physiological saline solution, suspended in phosphate buffer *p*H 6·2) as with acetone-dried bacterial preparations, which showed undiminished activity for at least one year. For analytical reasons only butyric acid was determined as essential C_4-product.

The C_1-atom of C_6-compounds does not play any part in the formation of C_4-products. Replacing the CHO-group of glucose by the COOH-group (gluconic acid), by the CH_2OH-group (mannitol, sorbitol) by introduction of phosphoric acid (hexose-*l*-monophosphate, Cori-ester), butyric acid was in all cases formed. On the other hand, replacing the CH_2OH-group at C_6 by the COOH-group (galacturonic acid), only acetic acid was obtained. Introducing phosphoric acid at C_6 (hexose-6-monophosphate, Neuberg-ester), only traces of butyric acid were formed. Using hexose-1,6-diphosphate (Harden-Young ester), only acetic acid was formed. Simultaneously, after some hours incubation, already appreciable amounts of methylglyoxal were observed. In this special case the sugar is therefore split into C_3-molecules.

Experiments with C_5-compounds showed, like hexoses, formation of C_4-compounds from *l*-arabinose and *l*-xylose. *d*-Arabinose was not attacked, but the corresponding *d*-arabitol formed C_4-products. *l*-Rhamnose gave also butyric acid. The C_4-compound erythritol was not decomposed by the bacteria.

The most important step was the investigation of the C_3-compounds. Phosphoglyceric acid, phosphoglyceric acid + glycerophosphate, *d,l*-glycerinaldehyde were not attacked at all; the latter even inhibited the fermentation of glucose. Pyruvic acid formed only pure acetic acid. Even in the presence of glucose, pyruvic acid formed *only* acetic acid.

Substrate	355·1 mgm. glucose	169·2 mgm. glucose 186·4 mgm. pyruvic acid	367·4 mgm. pyruvic acid
N/10 volatile acids (c.c.)	16·54	29·50	44·96
Ratio butyric/acetic acid	1 : 1	1 : 6	pure acetic acid
Butyric acid (mgm.)	72·78	37·08	

From these experiments it is concluded that pyruvic acid cannot be considered as an intermediate product for the formation of C_4-compounds. Davies and Stephenson[2] claim that butyric acid is formed from pyruvic acid. However, this result is in contradiction to my investigations. Koepsell and Johnson[3] recently published experiments with a cell-free water extract from cells of *Clostridium butyricum*. They obtained from pyruvic acid only acetic acid, carbon dioxide and hydrogen. The fact that this extract catalyses the evolution of gas from pyruvic acid but *not* from glucose forms a further proof for the view that the breakdown of pyruvic acid is *not* linked with the formation of C_4-compounds.

One single compound from the C_3-series yielded butyric acid, namely, glycerol. This shows that the formation of butyric acid must be a synthetic process, glycerol being condensed probably to a C_6-compound. It may be supposed that this condensation leads to a C_6-alcohol like mannitol and not to a C_6-sugar, as in experiments with alcohols (mannitol, sorbitol, arabitol, glycerol) the highest values for butyric acid were obtained. Further, it may be noted that Yamasaki and Simomura[4] isolated mannitol formed from glycerol by action of Aspergillus. It has already been established by Neuberg[5] and Iwasaki[6] that the C_3-compound dihydroxyacetone is not directly fermented by yeast but after previous condensation to hexose which could be isolated as hexose-monophosphate.

Glycolaldehyde was not attacked by the bacteria and even inhibited the fermentation of glucose. Sodium formate was not decomposed but had no toxic effect.

Conclusions: The obvious assumption that a similar enzyme system to that known to exist in yeast or lactic acid bacteria, which breaks down sugar into C_3-compounds, has to be discarded in favour of a different mechanism.

A detailed description of the experimental material will be published shortly elsewhere.

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Specific Diagnosis of Typhus Fever by Rickettsial Agglutination

IN a series of publications[1], we presented data demonstrating that guinea pigs, rabbits and monkeys can be immunized with formolized tissue cultures of Rickettsia and that the murine, flea-borne and human louse-borne strains were antigenically distinctive, each failing to produce immunity towards the other. The latter findings were confirmed by Zinsser and Castaneda[2]. Recently Plotz[3] confirmed the antigenic difference between murine and human strains of Rickettsia by the complement fixation method.

Since the Weil-Felix reaction, based as it is on the presence of a common antigen, does not differentiate between the two forms of typhus, we tried to ascertain whether specific Rickettsial agglutination can serve this purpose satisfactorily. Such a specific diagnostic test is of special importance for epidemiological reasons, in a country such as Palestine, where murine typhus is endemic and where the invasion of epidemic or louse-borne typhus is imminent.

The results presented below show that the two types of Rickettsia are antigenically distinct, thus confirming the previous immunological findings. They also indicate that Rickettsial agglutination can be used for early differential diagnosis of the type of infection. The data are admittedly limited, but because of the urgency of such a test it was thought desirable to report our findings at this time.

Alcoholized, formolized and untreated, purified suspensions of Rickettsia in buffered saline (*p*H 7·4) were used. The suspensions were prepared from yolk-sack cultures and standardized at a density giving clear agglutination. The organisms were added to various dilutions of serum in buffered saline, in the usual manner, and readings made after four hours in a water-bath kept at 42° C., and again

TABLE 1.

Type of disease	Day of disease	Weil-Felix, max. titre	Murine strain, max. titre	Human strain, max. titre
Murine	5th	1 : 100—	1 : 100+	1 : 50—
	10th	1 : 200+	1 : 200+	1 : 50—
	16th	1 : 800+	1 : 400+	1 : 50—
Human	6th	1 : 100+	1 : 100+	1 : 200+
	10th	1 : 200±	1 : 100+	1 : 800±
	16th	1 : 200+	1 : 100+	1 : 800+

after 18 hours at room temperature. We used two murine strains—one from Tunis (*T*) and one from Palestine (*K*); and three human strains—a local strain isolated from lice (*L*), a louse strain from Addis Ababa (*A*), and a strain isolated from a patient who came from the U.S.S.R. (*R*).

In six confirmed cases of murine typhus (either laboratory infections or by animal inoculations), during the second week of the disease, the range of the Weil-Felix titres was 100–1,000, that with murine strains 250–400 and with the epidemic strains 0–100. In six confirmed cases of epidemic or human typhus, about the end of the first or beginning of the second week of the disease, the range of the Weil-Felix reaction was 0–200, the titre with epidemic strains 80–600, and that with the murine strains, 0–100.

In twelve additional cases from a group known to be louse-infected, the agglutination titres with human Rickettsia antigens were as follows: 4–1 : 80; 5–1 : 160; 3–1 : 320.

The course of appearance of agglutinins in two typical cases of typhus, one murine and one human, is given in Table 1.

Only one serum of those tested thus far, a Palestinian patient, gave an equally high titre, 1 : 640, with both murine and epidemic strains. The significance of such a divergent result can only be ascertained when a large series of confirmed cases has been tested.

The specificity of these reactions was substantiated in two series of animal tests, as well as by the agglutinin absorption technique. The sera of guinea pigs, which recovered from an infection with blood from patients or with known human or rat strains, were titrated against both types of organisms three to four weeks after recovery. Of six animals which passed a typical rat-type infection, the range of titre of the sera with the murine antigens was 200–80, while that with human strains was 0–100 (murine, 2–200; 2–300; 1–400; 1–800; human, 1–0; 2–20; 1–50; 2–100). Of nine guine pigs which passed a typical human strain infection the serum titres with the louse strains were 200–800 (2–200; 6–400; 1–800), while those with the ra strains were 50–100 (6–50; 3–100).

TABLE 2.

Sera	Antigens					
	Murine		Human			Weil-Felix
	K	*T*	*A*	*R*	*L*	
Murine						
K 1	200+	200+	100+	100±		
2	400+	200+	200±	100±		
3	800+	400+	200+	200±	50+	50+
T 1	100+	200+	50+	50+		
2	200+	800±	100+	50+		
3	200+	800+	100+	50+	100±	100+
Human						
A 1	50—	50—	100±	50±		
2	100±	100+	400±	100±		
3	100±	100+	800+	200+	400±	100+
R 1	50—	50—	50—	50+		
2	50+	100+	200+	600±		
3	100±	100+	200+	800+	400±	200±

Finally, rabbits were immunized with formolize vaccines of four specific strains, two murine and tw human, and the cross-agglutination of their sera with the homologous and heterologous strains determined The sera of none of these animals gave Rickettsi agglutination before the injections. Three injection were given at intervals of one week and blood wa taken before the second and third injections, an two weeks after the last injection. The titres of th various sera with the homologous and heterologou antigens are given in Table 2.

These results show that the various Rickettsia strains tested fall into two types or varieties. Th strains of the murine type are closer to one anothe than they are to the human strains, and vice versa On the other hand, it should be noted that the strain of the various type are not identical but show individual antigenic patterns.

Absorption tests substantiate these results. On murine (*K*), and one epidemic serum (*A*), was absorbed with the heterologous strains and the titre of the absorbed sera for all strains determined. Th results are shown in Table 3.

TABLE 3.

	Titre against antigens				
	Murine		Human		
	K	*T*	*A*	*R*	*L*
Serum *A* (human strain) absorbed with strains					
T	50	0	600	200	200±
R	100	50	400	0	100
A (control)	200	100	800	200	200
Serum *K* (murine strain) absorbed with					
T	200	0	100	200	50
R	200	100	100	0	0
K (control)	800	400	200	200	50

It seems, therefore, that the Rickettsias have divers antigenic patterns with gradations between th various strains. It appears that along with th distinctive characters of the broad variants, th strains within the group show considerable antigeni overlapping and differentiation. The significant finding is that different strains of a given type hav different antigenic elements. These findings have bearing on the nature and efficacy of prophylacti vaccines. It is evident that, for the time being a least, and until the ideal strains are found, a polyvalent vaccine is called for. No single strain of given type can be assumed to give full protectio against another from a different source.

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Colour of Red Blood Corpuscles

I HAVE read with great interest recent communications on this subject which have appeared in NATURE[1]. I agree entirely with them, but another factor is, I think, involved, for when single red blood cells are looked at under a microscope they appear to be chrome yellow, lemon (barium) yellow or yellowish-green (crude auriolin) according to circumstances, whereas very dilute solutions of hæmoglobin look pale orange, beige or straw-coloured (yellow ochre) according to circumstances. In other words, there seems to be a greenish tinge visible in the cells which is absent from the dilute solution. Now, it is very easy for the eye to be misled in judging shades of colour when they are seen separately. Judgment is much more exact when the colours to be compared are seen side by side. This can be achieved in the following way.

Remove the eyepiece from an ordinary microscope. Unscrew the lenses and place them together so that they form a Ramsden eyepiece. Prick the finger and dilute the blood about 1 in 100 with normal saline. Place a drop of the mixture on a slide, cover with a cover slip and examine with a $\frac{1}{6}$-inch objective.

Prick the finger again, dilute the blood about 1 in 100 with distilled water. Place tiny drops of the mixture on a glass slide by means of a very fine paint brush. Place on a drop of xylol. Place this slide on top of the draw tube of the microscope. Examine the droplets with the Ramsden eyepiece, constructed as above, and focus the magnified images of the red cells at the same time. Shift the slides until a red cell and a droplet of solution are seen side by side in the eyepiece. The cells look greenish, whereas the solution looks orange; the difference in colour is usually quite striking. Droplets of different depths of tint may be tried, but none of them will be found to match the colour of the red blood cell.

The explanation is as follows. As is well known to the computers of optical objectives, the secondary spectrum due to uncorrected chromatic aberration tends to colour the edges of the images of all objects. The precise colours of the secondary spectrum depend on the two wave-lengths chosen for exact coincidence in the focal plane of the objective. In photographic objectives the colours of the secondary spectrum are often blue and yellow. In achromatic microscope objectives they are often blue-green and pink. In emi-apochromatic objectives they are often green and purple. These colours are well seen if an emulsion of two colourless fluids is observed with the microscope, uch as xylol vigorously shaken with water. The droplets should be colourless, but when seen under the microscope appear to be tinted green, blue-green or blue according to the objective in use, and to have surrounding them narrow rings which are purple, pink or yellow respectively. The precise colour of this surrounding ring is often obscured by other aberrations which are present.

Consequently, when objects such as cells are observed under a microscope the colour presented to the eye will be that which results from combining the absorption of the dye in the object with the secondary spectrum of the objective. In the case of red blood cells, the faint orange or straw yellow of the hæmoglobin is modified by the green, blue-green or blue contributed by the objective, as the case may be, causing the cells to appear yellow or even yellowish-green. In confirmation of this, experiment shows that when red cells are observed through a fully corrected apochromatic lens, their colour is no longer yellow or yellowish-green, but the unmodified pale orange or straw yellow of the hæmoglobin alone.

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[1] NATURE, 152, 331, 476 (1943).

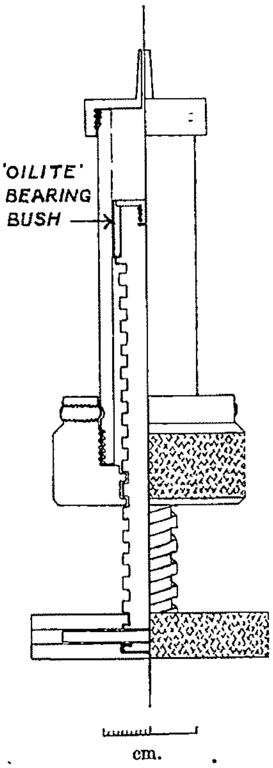
Intracutaneous Injection of Cattle

DURING the course of investigations on the production of immunity to foot-and-mouth disease the intracutaneous route of vaccination has been considered. It has generally been recognized that one disadvantage of this route in large animals is that, owing to the pressure required, only a small volume of inoculum can be injected at one site. Various attempts have been made in the past to overcome this difficulty, and by means of compressed air Curasson, Dischamps and Andryesky[1] found it practicable to inject 10 c.c. of their rinderpest vaccine into the skin of the bovine scrotum and vulva.

With an ordinary hypodermic syringe it is possible to inject up to 5 c.c. of a watery liquid into the skin of cattle, but the pressure required is too great to make the injection of a number of animals a very practical procedure; it is only with very great difficulty that a more viscous liquid such as serum or defibrinated blood can be injected in such a large dose. There is also a tendency with a hypodermic syringe for some of the inoculum to leak past the piston.

With the help of Dr. E. Schuster of the National Institute for Medical Research, Hampstead, a special syringe has been designed for this work. The principal difficulty of providing sufficient pressure has been overcome by making use of the mechanical power of the screw.

The salient features of this syringe are shown in the accompanying diagram. It is of metal construction. The capacity of the syringe is 10 c.c. and it is filled and emptied by turning the knurled wheel on the end of the piston rod, the pitch of the thread on the piston rod being so designed in relation to the bore of the barrel that one turn delivers 1 c.c. The syringe can be dismantled by loosening the grub screws on the collar, unscrewing the collar and withdrawing the piston from the barrel. It is essential that the piston fits the barrel very closely, and in order to prevent these two metal surfaces seizing, the sides of the piston are formed by an 'oilite' bearing bush. Such a bush consists of sintered bronze impregnated



with oil, and is normally used for providing a self-lubricating bearing. The purpose of its incorporation in this syringe is to provide a thin film of oil between the piston and the barrel. To avoid losing the oil from this 'oilite' bush the syringe must be assembled before sterilization. With an accurately fitted piston a pressure of 50 lb. per sq. in. can be easily obtained, and at this pressure there is only a slight and insignificant leakage of the inoculum past the piston. Brass and phosphor-bronze were used for the construction of this first model; but there is no reason why stainless steel could not be employed or the brass syringe could be cadmium plated. This is mentioned as it may be thought desirable to avoid the possibility of some of the metallic ions in these alloys exerting a deleterious effect on the inoculum.

By the use of this syringe it has been found that up to 10 c.c. of liquids of various viscosities can be readily injected at one site into the skin of the neck of cattle. A full account of this work will be published elsewhere.

I am indebted to Mr. M. Gilbee of the National Institute for Medical Research, Hampstead, for his painstaking work in constructing this syringe.

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Boiling Point and Viscosity

IN connexion with the communication by A. Dutta[1] connecting the ratio of η/η_B with that of T/T_B, where η represents viscosity, T temperature and the suffix B the boiling point condition, and obtaining a 'universal curve' for several gases it may be of interest to add the following facts.

From considerations of the mechanisms of both viscosity and evaporation, a relationship was obtained in 1939 for liquids in which the ratio η/η_B was found to be a function of T/T_B, expressed graphically[2]. It was found that certain groups of liquids, for example, homologous series, fell on a common curve. Further, there were three distinct regions describing associated, metallic and normal liquids. The position of these curves were further governed by the 'shape' of the molecule, but the most important consideration was the evidence from a fuller report of this work than my note appearing in NATURE, that "one law governs all viscous flow in all states of matter and that there must be a solitary equation giving the change, with temperature, of magnitude of viscous forces in flowing matter"[3]. This was in contradistinction from the prevalent view that the mechanism of viscosity in liquids is essentially different from that of gases. To formulate this universal law governing the viscosity-temperature relationship, the general equation for liquids,

$$\log \eta = K + K_1\left(\frac{T}{T_B}\right) + K_2\left(\frac{T}{T_B}\right)^2 + K_3\left(\frac{T}{T_B}\right)^3,$$

was solved[4]. It was found that all paraffins containing four or more carbon atoms are governed by

$$\log \eta_P = 6{\cdot}283 - 18{\cdot}572\left(\frac{T}{T_B}\right) + 17{\cdot}505\left(\frac{T}{T_B}\right)^2 - 5{\cdot}900\left(\frac{T}{T_B}\right)^3,$$

and further, that for the other liquids the viscosit at the same value of $\left(\frac{T}{T_B}\right)$ as that for the paraffi was governed by

$$\begin{aligned}\log \eta &= A - B\,(6{\cdot}283 - \log \eta_P).\\ &= C + B \log \eta_P.\end{aligned}$$

Further[5], as

$$\log \eta = A\,f(T) + \frac{Q}{2{\cdot}3RT},$$

where Q is energy of activation of viscosity, therefor

$$\Delta\left(\frac{Q}{T}\right) = -\,2{\cdot}3\,R\,\Delta\left\{18{\cdot}572\left(\frac{T}{T_B}\right) - 17{\cdot}505\left(\frac{T}{T_B}\right)^2 + 5{\cdot}900\left(\frac{T}{T_B}\right)^3\right\}$$

Thus the energy of activation, for the viscosity o liquids, in parallel with that of evaporation, wa found to decrease, ultimately, with temperature an vanish at the critical point. This is due to the fac that the energy of activation is the result of tw energies, a positive and a negative energy, bot increasing with the temperature but at unequal rates becoming equal at the critical temperature. Abov the critical temperature the negative energy is o greater arithmetical value than the positive, indicatin a rise of viscosity of a gas with temperature. A this involves working under the pressure of th saturated vapour. For low pressures the influenc of pressure is negligible.

At the present time work is proceeding on passin from the liquid to the gaseous state through th critical temperature, in the hope that if the singl equation for all states works as well with gases a liquids under these conditions, it may be extende to vapours and gases under different conditions.

There appears to be no doubt that the use of T/T as a criterion for levels of temperature affords distinc possibilities to the understanding of the mechanis of viscosity—possibilities not so readily availabl using other 'reduced temperature' scales.

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A Dental Survey of the British Isles

THIS is a general report on the effects of war-tim diet on the dentition of 9,400 youths in England an Wales, Isle of Man, Northern Ireland and Eire. I the last-named place until April 1943, meat, egg and milk, sweets and chocolate have not bee rationed; sugar and tea have since been controlle and butter only partially.

The scheme of assessment of dental decay employed in the investigation recognizes as bad or decayed, teeth extracted for orthodontic reasons, teeth lost as a result of caries or of accidents at games, and from all other causes. None the less, in the present survey only four cases were actually listed as due to accidents.

The factors controlling dental growth are proteins, fats, carbohydrates, minerals like calcium, phosphorus, iodine, iron, sodium, potassium, magnesium and copper; vitamins A, B, C, D; and hormone-secreting glands like the parathyroids. According to Fish[1] there is a factor, an immune saliva, a product of healthy general metabolism, which prevents dental decay and which is more frequently found in boys than girls. It is believed that excess of vitamin D is likely to lead to malformation of teeth, but Soma Weiss[2] denies the existence of any toxic effects from excessive administration of vitamins.

Vitamin A omitted from the diet will lead, among others, to infections of parodontal tissues and pyorrhœa. It is intimately connected with dental development.

The sources of the minerals and vitamins essential for perfect dental growth are dairy products such as eggs, butter, milk and cheese; marine fish and their oils; summer fruits, green vegetables and citrous fruits. "At the present time," wrote Prof. Mottram[3], "it looks as though the British diet may soon become deficient in first-class protein, iron and calcium and most, if not all, the vitamins."

The factors concerned in the etiology of dental caries are numerous, and even now are not all quite well understood. Miller of Berlin found that caries is due to *L. acidophilus*. Others maintain that gingivitis and dental decay may be due to food debris clinging to interdental spaces where the bacterial flora has optimal conditions for growth and multiplication. Most American workers hold the view that a pulpless tooth acts as a septic focus for the eventual infection and destruction of dental structure. Soviet workers like Entin of Leningrad and Lukomsky of Moscow reject the chemobacterial theory of American workers; but Entin believes in apical irritation, and Lukomsky in allergy, as etiological factors in caries. Both lay stress on diligently seeking means of preserving the teeth.

Lady Mellanby[4] found in 1929 that increased liability to dental disease and gross hypoplasia of teeth may be the result of defective maternal diet especially in mineral salts. N. Simmonds[5] states that the low incidence of dental caries among indigenous populations has not been the result of any one dietary regimen. Klein and Palmer[6,7] postulate the existence of caries immunes and caries susceptibles, but deny the influence of socio-economic status on the incidence of caries.

I believe that dental decay is due to the destruction of the dentine and enamel by bacteria, by refined foodstuffs like white flour, cereals, and white sugar, by chemical abrasives and by too frequently boiled milk, and occasionally by fluorine in drinking water.

In the accompanying table, of the total (9,400), 3,480 are from the public schools and colleges, 5,770 are factory girls and the rest from two model elementary schools.

No. of teeth lost	0 %	1 %	2–3 %	4+ %
Public Schools (ages 12–18)				
English boys	61·18	13·14	15·98	9·60
English girls	46·96	17·49	21·16	14·39
Welsh girls	48·64	14·25	21·05	16·06
Manx girls	62·00	7·00	17·00	14·00
North Irish boys	53·76	19·36	19·84	7·04
North Irish girls	57·00	16·67	19·47	6·86
Eireann boys	62·50	14·58	15·27	7·65
Eireann girls	50·87	16·37	24·00	8·76
Post Public Schools (ages 19–22)				
English T. Coll. girls	21·70	17·84	27·13	33·33
North Irish Elementary Schools (ages 10–14):				
Boys	41·50	27·00	23·50	8·00
Girls	55·00	20·00	15·00	10·00
Factory girls (N.I.) (ages 14–24)	10·00	5·00	35·00	50·00

It is obvious from the peculiar nature of the problem we set ourselves that any conclusions we may arrive at must form the point of departure for subsequent workers since there are no previous comparable data to work on. We may, we believe, safely infer from this sample that at least until July of this year (1943) war-time diet, scarcity of sugar, sweets and chocolates have had no damaging effects on the nation's teeth since the dental status of English boys and Manx girls approximate that of Eireann boys. It also follows that abundance of sugar and sweets has in no way destroyed the dentition of Eireann students.

It is only when we compare English college girls with English public schoolgirls, and Northern Irish factory girls with their schoolgirls, that gross differences in improvement of the younger generation become apparent. It is statistically significant that in both Eire and England more boys have perfect teeth than girls.

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Oct. 13.

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RESEARCH ITEMS

Tularæmia in Shrews

Glen M. Kohls, assistant entomologist, and Edward A. Steinhau, associate bacteriologist, confirm (*Public Health Rep.*, 58, 842 ; 1943) the occurrence of spontaneous tularæmia in the shrew (*Sorex vagrans monticola*) and the field mouse (*Microtus pennsylvanicus modestus*) by the following examinations of the animals. Three shrews and ten field mice were caught in traps. No gross lesions were found at autopsy, but the spleens and livers of each species were pooled and injected into four guinea pigs which died from six to twelve days later with gross lesions suggestive of tularæmia. *Pasteurella tularensis* was isolated from the spleen and liver of two of the guinea pigs given the shrew tissues and in three of those that received the field mouse tissues.

Tyroglyphid Mites in Stored Products

Tyroglyphid mites, which include cheese mites and flour mites, infest most kinds of stored products. They are common also on mushrooms and in laboratory cultures of insects. A vast amount of scattered information exists regarding these creatures, much of which is valuable but greatly in need of being collated and made more readily accessible. As a guide and introduction to the study and control of these mites a recent pamphlet by M. E. Solomon entitled "Tyroglyphid Mites in Stored Products", published by the Department of Scientific and Industrial Research, is to be commended (London: H M. Stationery Office, 1943. 9*d*. net). The knowledge thus brought together is well arranged under suitable headings and there is a bibliography of about 250 references. With few exceptions, the literature of the nineteenth century has been omitted, since it is listed and discussed in the well-known monograph of British Tyroglyphidæ by A. D. Michael. In the discussion at the end of this pamphlet it is pointed out that a long-standing need is for a unified system of classification with complete keys to the genera and species. This desideratum has to a great extent been fulfilled by the work of Zakhvatkin (1941). Its complete translation from the Russian would considerably assist British workers. The importance of moisture in the ecology of these mites is stressed. As a control measure, dry-storage of susceptible products is of first importance. There is also need for quantitative data on the rate of increase and damage done by mites under different conditions. Another requirement is more critical work on control measures, with special reference to the resistant egg and hypopus stages.

Feeding Apparatus of Biting Flies

R. E. Snodgrass has described and figured the mouth-parts of biting and disease-carrying flies as a war-time contribution to medical entomology (*Smithsonian Misc. Coll.*, 104, No. 1 ; 1943). As the author points out, most text-books of medical entomology do not describe the feeding organs of such insects in sufficient detail to be adequate. The present paper is intended to supplement such texts and thus to make available to teachers and students a condensed but detailed account of what is known to entomologists concerning the mouth-parts of the kinds of flies mentioned. The author has drawn freely upon modern literature on the subject besides incorporating observations of his own. As he points out, some of the most thorough investigators are specialists in a particular group, and do not give sufficient attention to other insects to make reliable interpretations of the homologies of some of the organs involved. A case in point is the use of the term *tormæ* by so many writers with reference to the anterior plate of the fulcrum. As pointed out by Patton and Cragg and also by Imms, this plate is the homologue of the clypeus of other insects. The memoir brings together, within convenient compass, a detailed account of the organs concerned, together with a number of clearly executed text figures, the majority being original. It can be recommended to investigators and teachers alike. A bibliography of the more modern literature on the subject is appended.

The *Rh*-Factor of Blood

It has been recently shown that the dominant agglutinable factor *Rh* of blood is associated with a specific disease of the newly born and that stillbirths and abortions may result from the interactions of the blood groups of mother and fœtus. P. Levine (*J. Hered.*, 34, 71 ; 1943) summarizes recent work and indicates that anæmia of the newly born, erythroblastosis fœtalis, results from genetic differences in the antigenic compositions of the erythrocytes of the parents. The actual mechanism depends on the iso-immunization of the mother by the *Rh*-factor in the blood of the fœtus and the intra-uterine interaction of maternal anti-*Rh* agglutinins on susceptible fœtal blood. Evidence is presented which indicates that other blood group factors may also be responsible for some forms of fœtal death (see also Nature, September 11, p. 300).

The Phæophyceæ

In the third paper of the series "Studies in the Comparative Morphology of the Algae", F. E. Fritsch discusses the possible interrelationships of the orders in this group (*Ann. Bot.*, 7, No. 25 ; 1943). The assemblage of forms included in Oltmanns' Ectocarpales (except the oogamous Sporochnales and Desmarestiales) illustrates experiments in elaboration of the diploid thallus, the most important of which is probably the development of polystichous (parenchymatous) forms by the appearance of division walls in various planes in the cells of the primary, heterotrichous thallus. In this group the growth is usually intercalary (trichothallic), but some members relatively early lose the part distal to the meristem and assume apical growth ; this point may be significant when considering the interrelationships of forms with apical and intercalary growth ; in Fucus the apical cell of the adult plant is preceded by a hair with intercalary growth in the juvenile stage. In spite of pointers of this kind in the Ectocarpales, Fritsch concludes that the more specialized orders have no direct affinities with one another and must be regarded as separate evolutionary lines emanating from simple filamentous forms with an isomorphic life-cycle. The lines of development accompanying the heteromorphic life-cycle show the higher degrees of somatic differentiation. The tabulated scheme indicates markedly the isolation of some of the orders. The higher orders receive independent discussion and comparison. The Tilopteridales still remain a problem in classification : Sauvageau's original contention, that the monosporangia on plants of either generation represent accessory asexual reproductive organs, seems to be supported by the more recent observation of larger, amœboid units liberated from lower compartments of the plurilocular sporangia of Tilopteris; possibly these may be female gametes and be equivalent to the swarmers liberated from the relatively large compartments of plurilocular sporangia of Acinetospora. Within comparatively recent years a considerable amount of literature has appeared, particularly in connexion with brown algæ, and these papers by Prof. Fritsch are very valuable in bringing the new work, some of which is in journals not always readily accessible, under discussion in a review of the present position of our knowledge of the algæ.

Taxonomy and Distribution of the Fungi

An interesting computation of the numbers of fungi by G. R. Bisby and G. C. Ainsworth (*Trans. Brit. Mycol. Soc.*, 26, Pts. 1 and 2; April 1943) places the world total at 37,500, of which about nine thousand have been recorded from Great Britain. These numbers are subject to constant addition, and in the same *Transactions*, two new species belonging to the mould genus Aspergillus are described by G. Smith. They are *A. avenaceum*, from dried peas, and *A. proliferans*, isolated from cotton. No special characters likely to be of use in industrial chemistry are reported, though the genus is otherwise rich in such activity. A further new species, *Sphaceloma Murrayæ*, is also described by Anna E. Jenkins and Leon Grodsinsky from New Zealand. It causes a destructive disease on willow, and was formerly considered to be a species of Glœosporium. A. A. Pearson, in the same journal, describes twenty-three new British records for Agaricaceous fungi, or species for which further descriptions are now available. They belong to most of the commoner genera, and two new combinations, *Astrosporian umboninota* and *A. Boltonii*, are perhaps of special interest since their extraction from the genus Inocybe is based upon well-defined spore characters. A very detailed account of British Nectrioideae and allied genera by T. Petch, published in the same volume, considers the highly coloured forms of Saccardo's assemblage the Sphaeropsideæ. It is chiefly a modern evaluation of von Höhnel's work on the same groups, with useful keys and descriptions of type-species.

oil Pests of the Potato

A short paper by G. Fox Wilson (*J. Roy. Hort. Soc.*, 68, Pt. 7; July 1943) describes several insect pests which live in the soil and attack potato tubers. Wireworms, slugs and millepedes are all too common visitors; but leather-jackets, cockchafer grubs and utworms also cause damage. Particular interest is ttached, however, to the inclusion of swift moth aterpillars as potato pests. These were formerly thought to feed mainly on the roots of grasses, but most horticultural advisers would agree with Mr. Fox Wilson that they have recently exhibited more predatory tendencies upon several food crops, including potatoes.

ariations in Radioactive Data

Information concerning the distribution of the adioactive elements in rocks is of fundamental eophysical importance because of the influence of adiogenic heat on the thermal behaviour and history of the earth. A report on recent work bearing on the causes of variation of such radioactive data has been given by N. B. and A. R. Keevil, W. N. Ingham and G. P. Crombie (*Amer. J. Sci.*, June 1943). The greatest differences—indicating variations in radioactive content by a factor of fifty or more from specimen to specimen—occur in certain granitic rocks, due mainly to varied concentrations of accessory minerals, chiefly zircon and apatite, which are often highly radioactive. It has also been discovered that in the case of the Bourlamaque batholith, Quebec, there is a marked concentration of the radioactive elements towards the border of the mass. The contact rocks of this area are also exceptionally radioactive, and since they are highly albitized and silicified it is reasonable to attribute the enrichment to diffusion of material from the batholith. Regional variations are less pronounced, but it is clear that certain provinces, as in Colorado and the Great Slave – Great Bear region, are relatively highly radioactive, whereas others, such as parts of Ontario and Quebec, are relatively barren. In sedimentary rocks the effect of mixing of materials from different sources tends to produce uniformity of radioactive content. It is clear from the general results of the survey that many more data from representative areas are necessary before the laws governing the distribution of radioactivity in the earth's crust can be fully elucidated.

Short-Period Erratics of Free Pendulum and Quartz Clocks

W. M. H. Greaves and L. S. T. Symms have discussed their investigations of the performance of Shortt clocks and quartz-controlled clocks during 1942 (*Mon. Not. Roy. Astro. Soc.*, 103, 4). The work is limited to short-period erratics, but recent developments suggest that the superior performance of the best quartz-controlled clocks extends to long-term performance. Three types of erratics were recognized. The first of these represents accidental erratics in the clocks themselves arising from random fluctuations, about a mean value, of the phase at which the seconds impulses are taken, and also includes errors of chronographic recording and measurement. The second type, accidental errors affecting the first differences, may arise from accidental fluctuations of rate about a mean value, or from accidental changes of phase, and it is impossible to distinguish these two kinds of erratics. The third type affects second differences and arises from accidental changes of rate. For clocks of the standard free-pendulum type, all three types of erratics are present in appreciable amounts, but for the quartz clocks the erratics of the second and third types are too small to be detected by the analysis, and erratics of the first type are predominant. The origin of erratics of the last type is obscure, but they exist in pendulum clocks, and as their effect on clock errors is cumulative, they are the most serious from the point of view of long-period performance. The second type of erratics also tends to produce a cumulative effect on clock errors, but, so far as long-period performance is concerned, they are not so serious as the third type. The first type of erratics does not affect the long-period performance of a clock. In so far as the long-period performance of a clock arises from the integrated effects of the short-period erratics, it is concluded that good quartz clocks are very superior in long-period performance to the best clocks of the standard free-pendulum type.

POST-WAR RELIEF IN EUROPE

IN opening a Conference, organized by the London Area Committee of the Association of Scientific Workers, on "Problems of Freed Europe—the Challenge to Medical Sciences", held on October 2, the chairman, Dr. Douglas McClean, pointed out that the task is one in which many aspects of science are deeply involved. Obviously experts in nutrition, agriculture, veterinary science and the medical sciences will have a considerable part to play in restoring reasonable standards of life; no less important will be engineers, architects, economists and a host of other trained people. It was the purpose of the Conference to direct attention to this point of view, to consider what the needs are likely to be, what mechanism and plans already exist, and in what ways they can be modified and improved.

The first part of the Conference was devoted to reports, from representatives of several Allied or occupied countries, describing the existing conditions so far as they are known. Dr. B. Kruta, chairman of the Czechoslovak Nutrition Committee, detailed the progressive diminution of supplies following the German occupation. The country was previously largely self-supporting in its food production; the producers are compelled to contribute quotas to the State-controlled retail corporations, with severe penalties for non-compliance, but are allowed to retain part of their produce for themselves, their families and animals, and for seed. The townsfolk are worse off in that they have fixed nominal rations but have no guarantee of actually being supplied. The general diet is deficient in fats, in vitamins and in energy content by 500–800 calories a day; the total protein content is low—about 40–50 gm. a day, of which only about 10 gm. is first-class protein. The greatest deficiencies occur in the diet of adolescents. The obvious malnutrition is accompanied by all the attendant increase in ill-health and disease.

Dr. A. Marteau told of similar, but even worse, conditions in Belgium where the bulk of the population has to exist on half a pound of poor-quality bread, 1 lb. of potatoes (in very irregular supply) and, when available, a few vegetables and 1 oz. of meat a day. Coupons for fats are issued, but the rations can often not be obtained. The position in Greece, reported by Dr. A. P. Cawadias (president of the Greek Red Cross) can only be described as complete famine, due mainly to the fact that the country normally produces only a very small proportion of its food requirements and is of very little value to Germany industrially or as a source of raw materials; its inhabitants are, therefore, not worth feeding. A certain amount of relief, equivalent to about 700 calories per head per day, has been reaching Greece since the spring of 1942, but it is quite inadequate to prevent the diseases of malnutrition and the epidemics which are rife.

Prof. S. A. Sarkisov (Soviet Red Cross) gave a picture of the tremendous amount of destruction of every sort which has followed the German invasion of the Soviet Union. Horses, cattle, sheep, grain and other foodstuffs in vast quantities have been removed, agricultural land put out of cultivation and buildings and machinery destroyed. As a consequence there is the usual tale of famine and disease. Already in the areas which have been liberated by the Red Army the work of restoration of hospitals and medical centres, housing and agriculture is proceeding. Feeding centres, public baths, kitchens, bakeries and sc on are set up immediately, and medical centres, with their supplies and equipment, as soon as possible.

Prof. J. R. Marrack then dealt with the present plans for relief. The problem after this War will be greater than after the last as more primary production centres have been involved and the East will also have to be considered. On the other hand, the Allied Post-war Requirements Bureau has been assessing the needs in food, medical supplies, seeds, livestock, etc., which will arise after the War, whereas, in 1918 relief had to start without plans. In addition, the United Nations Relief and Rehabilitation Administration (UNRRA) is being built up in order to deal with the problem. UNRRA will have power to distribute such stocks as may be available and to make appropriate plans, but will not have overriding power to obtain food, raw materials or shipping for transport The actual amounts needed will be small compared with total consumption of the United Nations and in most cases, could be provided readily if rationing in those countries were continued for a time after the War. Controls on transport would also need to be maintained in order to provide the means of getting the supplies to the people needing them. This should be the function of a Supreme Economic Council.

Mr. F. Le Gros Clark, in opening the discussion maintained that one of the chief duties of the relie organizations will be to co-operate with the national on the spot. Imports of all sorts should be made available as an inducement to local producers to par with surplus stocks and to remove the motive for and profit from, hoarding. Great care will be necessary in selecting personnel in order to avoid maladministration. Dr. Geoffrey Bourne pointed out that the occupied countries could be grouped according to the severity of their deficiencies determined by thei degree of self-support and the use of their industries to Germany. The main shortages everywhere are in calories, calcium, vitamins and first-class protein. Dr Bunting considered that one of the chief problems will be the restarting of agriculture and said that th problem will vary with each country liberated and with the season at which it occurred. He suggested tha local crops should be retained for seed, since they suit local conditions, and that imported produce should be used for food. Mrs. Bamford (of the Fabian International Bureau) stressed the importance of no allowing the withholding of relief to be used fo political blackmail. She agreed with Prof. Marrack that production and distribution should be under the control of a Supreme Economic Council and tha rationing should continue on the principle of "bread for all before cake for any".

Dr. Mark Daniels and Mr. W. D. Hogarth discussed the need for training personnel and the methods by which it could be achieved with th minimum of dislocation of the present position. Welfare workers have the requisite basic training, on t which special requirements could be fairly easily an quickly grafted. Dr. Ungar is of the opinion that mobile teams of physicians, bacteriologists, etc., wi be needed to deal with epidemics wherever the might break out. Dr. Kuczynski maintained that Germany must play its part in reconstruction by providing medical supplies, vitamin preparations instruments and so on, as well as general industria relief.

Dr. S. C. Dyke (president of the European Association of Clinical Pathologists) proposed that the Conference should pass a resolution urging on the overnment that there should be no relaxation of ationing until the needs of occupied Europe have een supplied. Mr. Le Gros Clark introduced an mendment that, as an essential preliminary, a wide ampaign of education be undertaken to explain to he public the necessity for such a measure. The mended resolution was carried with acclamation.

ATIONS AND FOOD CONSUMPTION IN SWEDEN DURING 1942-43

By CARIN BOALT and YNGVE ZOTTERMAN
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AN investigation of the individual food consumption of fifty-two households and one mbermen's canteen in Sweden has been made during he winter 1942–43. In seventeen of these households he breadwinner was a lumberman, in twenty a millorker, and in fifteen households a clerk in a factory r a bank. Thus men doing physically heavy outdoor ork, heavy factory work and very light indoor work ere represented. The total number of persons conrned was 212, of whom 76 were men, 59 women nd 77 children under fifteen years of age. The nvestigation continued for fourteen successive days, uring which the subjects weighed and checked all od eaten. Moreover, a complete account was kept ver household purchases of food and the food ceived in kind.

From these data calculations were made of the nsumption of different foods, the supply of the ore important food factors, the cost of food and e diet. This material makes possible comparative quiries into the influence of occupation, age and x upon the diet and standard of nutrition.

The lumbermen showed the highest consumption energy, with an average of 4,600 (large) calories for 4 hours, thereafter came the millworkers with 3,800 lories, and far behind them the clerical workers ith 2,600 calories. The women's consumption of ergy was 2,500 calories for lumbermen's wives and 200 calories for the other groups. The children's ergy consumption increased linearly with age. A ale of food energy standards has been worked out the basis of these results. This showed that the ildren's consumption of energy was higher than at was earlier reckoned on, while on the other nd the women's consumption was lower.

From the body-weight, height, age and sex, the sal metabolism of each subject was calculated cording to well-known empirical formulæ. In order to illustrate the influence of the occupation upon the energy metabolism, we have worked out what we call the activity quotient, namely,

$$\frac{\text{energy supply (net)} - \text{basal metabolism} \times .100}{\text{basal metabolism}};$$

in other words, the energy supply exceeding the basal needs was expressed as a percentage of this latter value. This quotient proved to be for the lumbermen 186, for the millworkers 132 and for the clerical workers 67 per cent. The total activity in regard to the physical work done in 24 hours thus varied as 3 : 2 : 1. The women showed in this respect a low activity quotient with 76, 59 and 58 per cent for, respectively, the lumbermen's, the millworkers' and the clerks' wives. The children showed a great dispersion ; no differences could be traced between boys and girls.

Comparisons between the consumption and the rations showed that the lumbermen exceeded their rations of flour and grain as well as fats by an average of 60 per cent. Even the millworkers exceeded substantially their rations of these foods, whereas the clerical workers and the women lived within their rations. For the youngest children, generally speaking, consumption was considerably below their allotments.

The investigation has accentuated the desirability of a strongly differentiated system of food rationing where the greatest possible consideration should be given to occupation, age and sex. A general principle during partial rationing should be to balance the rations so that an individual's energy requirement can be covered by a reasonable consumption of free foods. Thus it was shown that millworkers, whose rations gave 2,000 calories per day and whose energy consumption was 3,800 calories, received 2,500 calories from rationed foods and only 1,300 calories from free foods. Probably we must therefore reckon with the fact that in practice not more than 1,500 calories might be taken from such foods as milk, potatoes and other roots, which during the winter 1942–43 were not rationed in Sweden.

DAILY RATIONS IN SWEDEN IN FEBRUARY 1943

	Meal and grain (gm.)	Fats (gm.)	Meat (gm.)	Sugar (gm.)	Peas (gm.)	Cheese (gm.)	Eggs (gm.)	Calories contained in the daily rations
Children born 1942–43	152·0	35·7	14·3	60·6	8·0	4·2	5·4	1146
,, ,, 1939–42	152·0	35·7	14·3	60·6	8·0	4·2	5·4	1146
,, ,, 1938	193·7	35·7	28·6	60·6	8·0	4·2	5·4	1334
,, ,, 1936–37	193·7	35·7	28·6	60·6	8·0	4·2	5·4	1334
,, ,, 1931–35	214·5	44·6	28·6	60·6	8·0	4·2	5·4	1476
,, ,, 1927–30	235·3	44·6	28·6	60·6	8·0	4·2	5·4	1549
,, ,, 1924–26	235·3	44·6	28·6	60·6	8·0	4·2	5·4	1549
Ordinary rations	193·7	35·7	28·6	60·6	8·0	4·2	5·4	1334
Heavy workers	360·3	53·6	28·6	60·6	8·0	4·2	5·4	2060
Lumbermen living at home	443·7	53·6	57·1	60·6	8·0	4·2	5·4	2736
Lumbermen not living at home	402·0	53·6	55·6	100·0	18·7	4·2	5·4	2781
Pregnant women	193·7	53·6	28·6	60·6	8·0	32·8	22·5	1569

As concerns the children's consumption, certain foods, as, for example, flour and meat, showed a high correlation with age, whereas other foods such as milk and sugar did not show any increase with age. Among the adults there were great quantitative differences in the consumption of different foods between men and women in workmen's households. In the households of clerical workers, men and women had a very uniform diet.

The protein supply for men and children was kept well above the desirable level, while the women on average just reached this level, which means that a considerable number of women did not receive the desirable supply of proteins. This was particularly the case among the millworkers' wives. The supply of calcium and phosphorus was in the main satisfactory for all groups, whereas the consumption of iron among the smaller children and the women was below the desirable level.

The vitamin A supply showed a very wide dispersion. Starting from a minimum requirement of 2,000 I.U., the supply of vitamin A to the men of all three groups was above this value. The optimal supply of 4,000 I.U. has not been reached by any but a few lumbermen. Only one fourth of the number of the children seemed to have reached the optimal level for their age. With regard to the supply of vitamin B, the minimum and optimum requirement for adults is generally given as 0·75–1·50 mgm. vitamin B per day. The women and children have, on the average, not reached this optimum, and a few women showed a consumption below the minimum requirement. The supply of vitamin C was for all groups in the main above what has been considered to be the minimum, namely, 25 mgm. per day. The mean values for all groups of adults except those for the millworkers' and the lumbermen's wives were greater than 50 mgm., which is generally considered as the optimum. Among the children the supply of vitamin C was only exceptionally below 20 mgm. The mean value was about 40 mgm., but the dispersion was very great. The supply of vitamin C did not show any correlation with age, in contrast to the consumption of vitamin A and B, which increased linearly with age.

In conclusion, it can be said that the diet of our subjects seemed to be relatively satisfactory according to generally accepted ideas.

The women's consumption of food was, however, so small that their intake of iron and of vitamins A and B became rather low. The fact is, however, that the relation between the energy metabolism and the requirement of the different food factors is not as yet sufficiently well known to permit us to draw any safe conclusions concerning the women's nutritional standards. The same is the case in regard to the children's requirement of minerals and vitamins at different ages.

The money value of the food has been computed for all household groups and subjects by adding together the cash outlays for food and the value of the produce received in kind. The cash outlays for food for fourteen days amounted to 48 Sw. crowns for the lumberman's household, 51 crowns for the millworker's household and 71 crowns for the clerical worker's household, which was equivalent to 53, 39 and 28 per cent of the respective cash income. The total value of the food amounted to respectively 75, 58 and 76 crowns.

The cost of the daily food was on the average 1·73 crowns for the lumberman, 1·96 crowns for the millworker and 1·70 crowns for the clerical worker. The cost of food per 1,000 calories was respectively 0·38, 0·52 and 0·65 crowns.

Concerning the children, the food cost for the young children was about 0·90 crowns a day and for the school-children about 1 crown a day. The increase with age was thus inconsiderable. On the other hand, the food cost for the children belonging to clerical workers' families increased from 1 crown to 1·50 crowns. These children enjoyed also a relatively more expensive diet than the children of the manual workers. Thus the price per 1,000 calories for young children belonging to clerical workers' households was 0·73 crowns, whereas food of the clerical workers' young children cost about 0·50 crown.

These figures might be taken as an expression for the difference in the standard of diets between the household groups in question. The lumbermen's households, where the men as well as the women and the school-children showed a higher food consumption than in the other household groups, lived upon a cheaper diet, which, however, in qualitativ respect was not inferior to that of the other groups Their diet was, however, rather monotonous. Th clerical workers' households, which showed the lowest food consumption but the highest food expenses, showed, however, from the qualitative aspec a standard which was only insignificantly higher Their diet was, however, much more varied, which among other things expressed itself in their choice of dishes and variation in the way of preparing them

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THE ELM TREE

By ALEXANDER L. HOWARD

THE elm tree, which on account of its peculiar habit of growth has become an outstandin feature of the English countryside, of which the genius of both British and Continental painters hav taken full advantage, seems doomed to extinction the tree is beset by too many enemies. With the breaking up of the large estates there is n one left to preserve it. For upwards of one hundred years no Government has existed in Great Britain which has shown any well-defined interes or devoted any tangible efforts towards reafforestation, and only in the course of the last twenty years or less, has the subject been given consideration Even during this period the main effort has been directed towards the financial rather than the nationa aspect.

It is interesting and instructive to contrast the labour and pains taken by those who preceded us—Virgil, Pliny, Evelyn and others—to ensure a plentifu supply of trees with those feeble efforts which ar practised to-day. For upwards of two hundred years few foresters have studied the means of the reproduction of elms, or the dangers imminent to the young trees, although we have possessed the knowledge of every kind of device, with explicit instructions as to how to plant, rear and establish them.

Although the life of the elm may be sustained fo upwards of six hundred years, and it is rarely struc by lightning, it is very liable to be blown down The roots, travelling horizontally, will not hold dow their weight. At an earlier age than other trees th elm is apt to become rotten at the heart. The tre is a prey to elm bark disease, which is very destructive; and what is worse, man has been very crue and unkind to it. As an example of disease, th beautiful avenue of elms in Windsor Park has bee condemned as beyond recovery. The wood, althoug ill-considered and costing less than that of mos hardwood trees, is, nevertheless, extremely useful and indeed more generally employed than is commonly known.

There are about twenty species, of which onl two are prominent in the United Kingdom—the common elm (*Ulmus campestris*) and the wych elm (*Ulmus montana*)—with perhaps nine or more hybrids or varieties. Whether the common elm or its varieties have been introduced or are indigenous to Great Britain is in doubt, but it seems generally accepted that the wych elm is indigenous.

The common elm was largely planted by our forefathers as roadside trees and avenues, and has become especially prominent in our hedgerows, while the latter has been extensively cultivated around the stately mansions and in parks throughout the country.

Boulger says of the wych elm :

> "Though more abundant to the north of the Trent, it is, wherever it occurs, less distinctly a hedgerow tree han its congener, though its name *montana*—the Mountain Elm, which seems to have been applied to it in very ancient times, is not very appropriate."

Strutt says in his "Sylva Britannica" that the common elm is indigenous to England, and we hear hat the Romans made a practice of feeding their cattle on its leaves—a use which would probably urprise the extravagant farmer of a later age.

Evelyn, in his "Sylva", says of the Dutch elm, which he terms *Ulmus Hollandica* :

> 'was brought from Holland about the beginning of the reign of King William, and was employed in forming edges in gardens ; but that taste being now justly exloded, the tree is no longer noticed in this country."

Evelyn states that

> the Wych Elm [which he calls] *Ulmus campestris*, is the only species that grows in Great Britain, the rest eing varieties."

Other authorities do not appear to agree with him. As regards his statement that the Dutch elm "is no onger noticed in this country" his opinion may have een well founded in his time, but to-day great numbers of Dutch elm (*U. major*) are to be found in the woodlands, gardens and parks of the landed entry and municipalities. Of late years the wood f the Dutch elm has been sought in preference to ither that of the common or the wych elm, but it is oubtful if in general it serves so many useful purposes as the wood of the latter.

As has been seen, according to Elwes the common elm is termed *U. campestris*, the name originally given by Evelyn to the wych elm. Elwes quotes as ollows :

> "John Harrison, nurseryman at Cambridge, plainly means *U. campestris* by the English Elm, in his New Method, 33 (1766): 'That which we call the English Elm, is peculiar only to the southern part of this island, where it grows wild in hedgerows : there is not a trace of that kind to be seen in the northern counties, but what has been planted within seventy or eighty years ; and these are either in avenues or some plantations near entlemen's seats.' "

Elwes also gives an account of a very remarkable elm at Huntly Manor, Gloucestershire, the seat of Mr. R. St. John Ackers, which has a watercourse running through the middle of the root. He says :

> "Mr. Ackers tells me that if you put a ferret into the oot on one side, it can pass through and come out on he other, which shows that the butt is partly hollow, hough the tree looks sound and is about 100 feet high. It is difficult to explain the origin of this curious freak."

ccording to Boulger the common elm is *U. surculo'sa.*

Authorities differ as to the origin of the term 'wych', sometimes spelt 'witch', and it has been sometimes, especially in the south, called 'wych hazel', the word 'hazel' having been applied probably owing to the fact that the leaves resemble those of the hazel, while the name 'wych' may have been taken, as Dr. Prior thought, from the early English 'hwaecce', the French '*huche*', a chest, our modern 'hutch', the wood of this tree having been used for these purposes.

Boulger refers to the origin of the name wych elm, and quotes Turner in his "Names of Herbes" (1548) :

> "Vlmus is called in greeke Ptelea, in englishe an Elme tree, or a Wich tree, in duch ein Vlme baume, or Ylmen or Rust baume, in frenche Orme",

the latter name 'rust baume' being the common name by which the wood is known in those countries where it is used more extensively than here, namely, Austria and Hungary, to which reference will be made later.

The habit of the two trees differs widely, the beauty of the common elm being in its unusual and distinctive manner of growth, forming somewhat the appearance of a series of rows of green sprays, one above the other at intervals ; while the habit of the wych elm is majestic and stately, the branches adorned by deep green leaves, which spread in graceful sweeps from the noble crown, descending often to the very ground beneath. The foliage again varies : in the early spring the common elm displays tender shoots which are almost of a purple colour, turning later to a vivid green, and changing in the autumn to a golden tint, while those of the wych elm hold their dark green colour throughout. A very graceful specimen of this tree may be seen in full vigour by the wide road across Rotten Row, in Hyde Park, London.

The Cornish elm, named by Evelyn *Ulmus sativa*, and by Elwes *U. stricta*, must not be overlooked. It will not compare with the common or wych elm for beauty or majesty. While it may perhaps be suitable for avenue trees for towns and villages, since the trunks or branches are not so apt to break away, it has otherwise little attraction. Of all the species we have, the wood of the Cornish elm is the nearest approach to that of the Canadian rock elm (*U. racemosa*) ; but perhaps while it is useful for a great number of purposes, it is not so suitable for boat boards as the wych elm.

While the timber of the elm has been the least costly of any hardwood obtainable, and consequently has been in large demand, the uses for which it has been employed have been greater than of any other British-grown hardwood. For the making of coffins immense quantities have been consumed. In the days of wooden ships it was used for keel pieces and in places where it would be in contact with the water, being eminently suitable for both these purposes. The builders of a modern ship, built in 1928, made use of an oak keel piece, bolted to the iron keel by iron bolts, measuring three feet long by three quarters of an inch in diameter. The ship being hauled up for repair, the keel in September 1943 revealed that while the iron bolt was perfectly sound in that portion which had not been in contact with the oak, twelve inches of the rod where it was in contact was entirely disintegrated by the action of acid. An experienced shipwright gave it as his opinion that had the keel been made of elm the iron would have remained sound.

Elm was used in earlier days for water pipes, and only quite recently such pipes were taken up in

Tottenham Court Road and Euston Road, London, and found to be perfectly sound, although they had been in use for more than a hundred years. Some of the actual pipes were exhibited at the Royal Institution a few years since.

Immense quantities have been absorbed for boxes for tinplates, and for seats of chairs and benches, for which elm is admirable. It is used by barge-builders, wheelwrights and for the making of boxes and wagons.

According to Boulger :

> "Gerard tells us that formerly longbows were made from the wood of this species, and its tough bark was made into ropes."

Both the Dutch and wych elm are highly esteemed for boat boards, the latter being preferred. It is used extensively for rubbing pieces for the sides of wharves and piers, where its tough grain provides resistance to blows, and its durability under water is exceptional ; for the wooden walls of farm buildings, and houses, and has been employed for floorings, but its use for the last-named cannot be recommended. Formerly it was used for chests and partitions for storing all kinds of farm produce and utensils ; and for steps and staircases in buildings of all kinds, but for this use it has fallen into disrepute, as the wood will expand and contract with the changes of atmosphere, and is liable to the attack of fungus and beetle. In country places it has been used for pews and seatings in churches, but is generally found severely damaged by lyctus and zestobium beetles.

Throughout Austria and Hungary it has been largely employed for interior house decoration of all kinds, and held there in great esteem. Of late years it has been in demand for high-class work in panelling, etc., in London and elsewhere, being specified by well-known architects. It is doubtful whether the high cost of manufacture, the difficulties arising in seasoning, and its uncertain behaviour after completion, warrant its continued use. In this direction the wood of the Dutch elm was found more satisfactory than of either wych or common elm, both the latter giving trouble.

Elm burrs, carefully selected, as many are too faulty for use, have provided, nevertheless, a limited quantity of most attractive specimens for ornamental woodwork, and a good elm burr will compare favourably for such work with any other kind of wood which can be employed. Elwes mentions many notable examples, and during the last twenty years elm burrs have been in great demand and have commanded high values. Probably the greatest quantity absorbed in one effort was the decorative woodwork for the S.S. *Queen Mary*, where hundreds of flush doors were faced with elm burr, also the dado panelling of the main staircase, the panelling of the main hall and the writing rooms. Some of these burrs were exceptionally fine, the colour varying from a golden to a deep reddish-brown, but always attractive. Whereas in general the work stood well, a certain number of the flush doors cracked and blistered. The very unusual strain on any wood subject to the changes of atmosphere and climate of a sea voyage, and especially that of the Atlantic, suggests that an elm burr which has been found to stand wear and tear in the ordinary way is scarcely the best medium to be employed for ocean-going ships.

A Frenchman, Bernard Palissy, in the sixteenth century, said :

> "I have often wished to make a list of the arts which would cease if there was no longer any wood, but when I had written down a large number of them, I found there would be no end to the enumeration, and, after due consideration, I came to the conclusion that there was not even one trade which could be carried on without wood."

Fortified by the Act of Parliament which made it a capital offence to cut a tree down, confirmed by Elizabeth in the sixteenth century, for nearly two hundred years planting of trees was encouraged and practised throughout the country. Science applied to forestry was not thought of, nor were scientific methods employed. Can we rise to the occasion recognizing to the full the disastrous consequences of delay, following scientific methods and instituting and carrying on a wide embracing measure of re afforestation ?

G. M. Trevelyan has said :

> "In matters of amenity (the) Government in our island is by long tradition heartless and witless. In old days this did not matter, because then landlords were able to beautify the country-side with country houses, parks avenues, gardens, well-kept agricultural estates, and above all with plantations or old English forest trees". . . a they seldom will today.

and further :

> "It (the Government) should charge itself with a generous policy of planting the slow-ripening forest tree of England. The State will still be there in time to com to enjoy their financial value, and the English people will still be there to enjoy their beauty. The Government ought to charge the Forestry Commission with thi policy on a large scale."

Those of our legislators who reach a position o power over the destiny of the country shoul recognize the alarming situation. England with out her woodlands could no longer maintain her people.

It is a curious thing that although the planting and care of trees is little thought of, our people—men, women and often children—have always displayed the utmost interest, and even a possessiv attitude towards the old trees which have bee familiar to them from their youth upwards : the former of these two strange characteristics has no doubt insensibly continued from the time when the British were tree worshippers and practised only the religion of the Druids. The latter, however, should be more seriously considered, because it is evidenc of a valuable instinct which wiser Governments migh have seen and fostered. Illustrating the foregoing an elm tree in a village in Hertfordshire displaye a large burr which the Lord of the Manor sold When the men came to fell the tree the villager prevented them. By order of the Lord of the Mano the men returned in the small hours of the morning whereupon the villagers set the tree on fire an destroyed it, rather than their cherished tree shoul pass into the hands of a stranger.

Since the time of Evelyn (*circa* 1660) successiv Governments, while neglecting the subject of forestry have continued to tax more and more heavily thos few owners of woodlands, without the least regar to the well-being of the community. A contrar policy, wisely followed, even had it only been adopte throughout the last fifty years, would by now hav provided a revenue for the remission of taxatio instead of increasing the already heavy burden.

ORGANIZATION OF SCIENTIFIC AND INDUSTRIAL RESEARCH IN INDIA

TWO articles on the Government organization of scientific and industrial research in India appear n the July issue of *Science and Culture*. One of these escribes the present organization, which now comrises the Board of Scientific and Industrial Research, he Council of Scientific and Industrial Research, the ndustrial Research Utilization Council and the Comittee for the Publication of a Dictionary of Raw Materials. The Council is the supreme body, the oard having now been reduced to the position of n advisory body for scrutinizing schemes of scientific search. A large number of sub-committees are ppointed from time to time to act as auxiliary dvisory sub-committees to the Board and Council, hile the Industrial Research Utilization Council dvises on the utilization by the industries of searches completed by the Board. The Board mainins a research laboratory which was transferred to elhi in 1942.

The article, in a critical review, directs attention the defects of the present organization, notably e overlapping in the functions of the officers and e absence of co-ordination, the complicated produre for dealing with research schemes and prosals, and the absence of any continuous programme f research and of a national laboratory. The writer f the article contrasts the development of the rganization with that of the Department of Scientific d Industrial Research in Great Britain, drawing eely on an article marking the twenty-fifth anniverry of the Department which appeared in NATURE of ay 11, 1940, and stresses the importance of adinistration being in the hands of professional ientific men, of enlisting the active co-operation of scientific talent in the country, of establishing merous research laboratories for the study of subts of national importance which cannot be carried t in the university laboratories, and of encouraging searches in pure sciences and raising a large search personnel by the establishment of many search fellowships and stipends under university ofessors.

The second article outlines proposals for reform. Department of Scientific and Industrial Research, th the status and rank of an "Attached Departnt" to the Commerce Department of the Governnt of India, should be constituted. The principal ecutive officer should be a full-time secretary who ould be a senior scientific man with administrative ilities and a good record in scientific research. The uncil of Scientific and Industrial Research should the parent body, and its functions should be to y down broad features of policy, receive grants m the Government and consider the reports of the ientific and Industrial Advisory Boards. It should courage and promote scientific and industrial search, suggest measures for the development of riculture and industries, and promote scientific rks of national importance. The Council should assisted by two principal advisory boards, taking places of the present Board of Scientific and dustrial Research and the Industrial Research ilization Council, respectively. The Scientific visory Board should have a distinguished nonicial scientific man as chairman and members awn from eminent men of science representing different sciences, and should be the principal body for supervising and laying down programmes for scientific and industrial research, with a scientific man as full-time secretary.

The present research committees should be reorganized, with separate secretaries, and should prepare the programmes of research in their respective fields for the guidance of the Scientific Advisory Board. The research institutes should be under the direct supervision of the Department, and the directors of research would be directly responsible to the Council and act as secretaries of the respective governing bodies of their Institutes. The Industrial Advisory Board should be the main body for advising on all matters concerning the utilization of researches, establishment of new industries, etc., with a non-official industrialist as chairman and an industrial economist as secretary. The Industrial Exploratory Committees should be under the Industrial Advisory Board. There should be a board of assessors for sanctioning the work of the various bodies and laboratories under the Department with a membership of industrialists, scientific men, representatives of Government Departments concerned and some members of the Legislature.

CONTROL OF THE INSECT ENEMIES OF LAC

IT is estimated that insect enemies destroy about 40 per cent of the total lac crop in India every year. The importance of this feature is all the greater for the reason that the people affected by the loss are mainly the poorest cultivators of the country. The chief insect enemies are predators and parasites: the first-named include the larvæ of two species of moths and the parasites are represented by more than eight species of Chalcid wasps. There are three general methods of controlling such enemies—biological, cultural and artificial controls. The principle of biological control has not so far been adequately investigated as regards the lac insect. Cultural methods, although useful, have greater limitations. Artificial methods, on the other hand, are valuable either independently or in conjunction with either of the other two methods. With regard to artificial control, fumigation is a well-known and efficient means, but it is not possible for the Indian cultivators to resort to it unless properly organized fumigation centres are maintained by an outside authority in every village or group of villages. The other method of artificial control is water-immersion.

This subject is discussed by P. S. Negi in Bulletin No. 50 (1942) of the Indian Lac Research Institute. The advantage of this means of control is its ease of application, involving practically no extra expense. It requires only water for immersion and sunshine for the subsequent drying of the lac. It is recommended that the shoots bearing the lac be submerged to a depth of at least two feet for a period of three days either in running water or in stagnant pools This procedure prevents a large number of insect enemies emerging from the lac when stored. The lac is, moreover, more easily scraped from the twigs after such immersion. Shellac manufacture, and physical as well as chemical tests, show that the yield and properties of shellac are not adversely affected by the water-immersion.

FORTHCOMING EVENTS

(*Meetings marked with an asterisk * are open to the public*)

Monday, November 29

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. H. A. Cox: "Timber—Uses New and Old" (Cantor Lectures, 2).

ASSOCIATION OF AUSTRIAN ENGINEERS, CHEMISTS AND SCIENTIFIC WORKERS IN GREAT BRITAIN (at Austrian Centre Swiss Cottage, 69 Eton Avenue, Hampstead, London, N.W.3), at 7.15 p.m.—Mr. John F. Shipley: "The Role of Meteorology in Engineering Enterprise".

Tuesday, November 30

INSTITUTION OF CIVIL ENGINEERS (STRUCTURAL AND BUILDING ENGINEERING DIVISION) (at Great George Street, Westminster, London, S.W.1), at 5 p.m.—Dr. Oscar Faber: "Difficulties Encountered and Overcome in connexion with Constructional Works".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. J. C. Drummond: "Food Problems of the Post-War Years", 2: "Food Research".*

Wednesday, December 1

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mrs. Goldsworthy: "Education To-day and To-morrow", 2: "Nursery and Infant Schools".

SOCIETY OF CHEMICAL INDUSTRY (FOOD GROUP) (joint meeting with the SOCIETY OF PUBLIC ANALYSTS) (at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1), at 2.30 p.m.—Dr. J. C. Drummond, Dr. H. E. Cox and Dr. E. B. Hughes: "Nutrition of the Public and Food Legislation".

GEOLOGICAL SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Scientific Papers.

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Dr. T. S. Littler: "Electrical Hearing Aids"; Mr. C. M. R. Balbi: "A Basis for the Prediction of Performance of Hearing Aids".

Thursday, December 2

BRITISH SOCIETY FOR INTERNATIONAL BIBLIOGRAPHY (at the Science Museum, Exhibition Road, South Kensington, London, S.W.7), at 2.15 p.m.—Symposium on "Film Classification, Conservation and Projection".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Prof. W. Perceval Yeats: "Links between Ancient China and the West: a Study of Exchanges in Material Culture", 2: "Ancient Commerce with the West".*

CHEMICAL SOCIETY (joint meeting with the UNIVERSITY COLLEGE PHYSICAL AND CHEMICAL SOCIETY) (in the Chemistry Lecture Theatre, University College, University Park, Nottingham), at 4 p.m.—Dr. H. J. Emeleus: "Some Properties and Reactions of Anhydrous Hydrofluoric Acid".

Friday, December 3

ASSOCIATION OF APPLIED BIOLOGISTS (at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1), at 11.15 a.m.—Discussion on Slugs (to be opened by Mr. K. F. Barnes and Mr. D. C. Thomas).

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—Dr. C. C. Paterson, F.R.S.: "Dies from Diamonds and their Use: a Triumph of Technical Precision".

INSTITUTION OF MECHANICAL ENGINEERS (APPLIED MECHANICS GROUP) (at Storey's Gate, St. James's Park, London, S.W.1), at 6 p.m.—Dr. L. Fox and Dr. R. V. Southwell, F.R.S.: "On the Stresses in Hooks and their Determination by Relaxation Methods".

CHEMICAL SOCIETY (at the Royal Technical College, Glasgow), at 7.15 p.m.—Prof. G. M. Bennett: "Some Aspects of the Formation of Ring Compounds".

Saturday, December 4

GEOLOGISTS' ASSOCIATION (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. Alan Wood: "Basic English and its use in Geology" and "Organs of Reproduction in the *Solenoporaceæ*".

SHEFFIELD METALLURGICAL ASSOCIATION (joint meeting with the SHEFFIELD SOCIETY OF ENGINEERS AND METALLURGISTS and the IRON AND STEEL INSTITUTE) (at the Royal Victoria Station Hotel, Sheffield), at 2.30 p.m.—Discussion on the Fourth Report of the Oxygen Sub-Committee.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

TECHNICAL OFFICER to work in a particular district of the county—The Secretary, Berkshire War Agricultural Executive Committee, 1 Abbot's Walk, Reading (December 3).

EDUCATIONAL PSYCHOLOGIST—The Secretary for Education, Education Offices, York (December 4).

LABORATORY TECHNICIAN FOR THE VETERINARY LABORATORY—The Secretary, Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh (December 7).

VETERINARY OFFICERS to fill vacancies in Government and other services in New Zealand—The High Commissioner for New Zealand, 415 Strand, London, W.C.2 (December 13).

REGIUS PROFESSOR OF ZOOLOGY at Glasgow University—The Priva Secretary, Scottish Office, Fielden House, 10. Great College Stree London, S.W.1 (January 17).

ASSISTANT WORKS MANAGER (AERO-ENGINES) for Royal Air For repairs in India—The Ministry of Labour and National Servic Central (Technical and Scientific) Register, Alexandra House, King way, London, W.C.2 (quoting Reference No. C.1525.A).

PAINT CHEMIST for service in the Army Overseas—The Minist of Labour and National Service, Central (Technical and Scientifi Register, Alexandra House, Kingsway, London, W.C.2 (quoti Reference No. F.1790).

LECTURER (Honours graduate) IN MECHANICAL ENGINEERING, and LECTURER (Honours graduate) IN MATHEMATICS—The Secretar Woolwich Polytechnic, Woolwich, London, S.E.18.

ASSISTANT MASTER (graduate) FOR MATHEMATICS, SCIENCE AN DRAWING, in the Ashton-under-Lyne Junior Technical School f Boys—The Director of Education, 8 Warrington Street, Ashton-unde Lyne, Lancs.

METALWORK INSTRUCTOR—The Principal, South Dorset Technic College, Newstead Road, Weymouth.

SCIENCE GRADUATE (Reading or Swanley preferred) to teach GENER SCIENCE part-time in Day Technical School for Girls and PRODU SUBJECTS to Women's Institutes in area of East Kent—The Princip Technical Institute, Longport Street, Canterbury.

DESIGNER OF VENTILATION EQUIPMENT required by the Admiral —The Ministry of Labour and National Service, Central (Technic and Scientific) Register, Advertising Section, Alexandra House, King way, London, W.C.2 (quoting Reference No. C.1874A).

REPORTS and other PUBLICATION

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

London Bird Report for 1942: an Annual Report on Bird-L within Twenty Miles of St. Paul's Cathedral. Edited by R. S. Fitter and E. R. Parrinder. Pp. 24. (London: London Natu History Society, c/o London School of Hygiene and Tropical Medicin 1*s*. 6*d*. [19

Bibliography of Meteorological Literature. Prepared by the Ro Meteorological Society with the collaboration of the Meteorologi Office. Vol. 5, No. 4, July–December 1942. Pp. ii+47–70. (Londo Royal Meteorological Society.) 2*s*. 6*d*. [19

British Association: Committee on Post-War University Educati A Note on Universities and the Education of Teachers. Pp. 9. (Lo don: British Association.) 6*d*. [20

Federation of British Industries. Industry and Research: Rep of the F.B.I. Industrial Research Committee. Pp. 24. (Londo Federation of British Industries.) [20

Scientific Proceedings of the Royal Dublin Society. Vol. 23 (N.S No. 16: Atmospheric Pollution in Dublin during the Year 19 By A. G. G. Leonard, Bridget P. McVerry and D. Crowley. Pp. 16 170. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams a Norgate, Ltd.) 1*s*. [21

Other Countries

Commonwealth of Australia: Council for Scientific and Indust Research. Bulletin No. 151: The Control of St. John's Wort (*Hyp cum perforatum* L. var. *angustifolium* D.C.) by Competing Past Plants. By R. M. Moore and A. B. Cashmore. Pp. 23+5 plat Bulletin No. 156: Standardized Plant Names; a List of Standardi Common Names for the more Important Australian Grasses, ot Pasture Plants, and Weeds. Pp. 99. Bulletin No. 160: The Outbre of the Australian Plague Locust (*Chortoicetes terminifera* Walk.) in Season 1939–40, with Special Reference to the Influence of Clima Factors. By Dr. K. H. L. Key. Pp. 40. Bulletin No. 163: Tra mission of Potato Virus Diseases. 1: Field Experiment with L Roll at Canberra, 1940–41, by Dr. J. G. Bald and D. O. Norris; The Aphis Population of Potatoes at Canberra during 1940–41, D. O. Norris and Dr. J. G. Bald. Pp. 32. Industrial Chemistry Circu No. 2: Investigation of Low-Tin and Tin-Free Solders. By H. Worner, H. T. Greenaway and J. H. Buckley. Pp. 16. Indust Chemistry Circular No. 3: Melting and Casting of Magnesium Allo By H. A. Stephens. Pp. 28+4 plates. (Melbourne: Gove ment Printer.) [

Asutosh Museum Series No. 2: Museum Method and the Proc of Cleaning and Preservation. By Minendra Nath Basu. Pp. viii+ (Calcutta: University of Calcutta.) [

Report of the Haffkine Institute for the Years 1940 and 19 By Lieut.-Colonel S. S. Sokhey. Pp. ii+84. (Bombay: Governm Printing and Stationery Office; London: High Commissioner India.) 6 annas; 8*d*. [

Indian Association for the Cultivation of Science. Annual Rep for the Year 1942. Pp. 18+22. (Calcutta: Indian Association the Cultivation of Science.) [

Smithsonian Institution. War Background Studies, No. 14: Isla and Peoples of the Indies. By Raymond Kennedy. (Publicat 3734.) Pp. iv+66+21 plates. (Washington, D.C.: Smithson Institution.) [

Proceedings of the American Philosophical Society. Vol. 86, N (September 25, 1942): The Early History of Science and Lear in America; Papers read before the American Philosophical Soci Midwinter Meeting, February 13–14, 1942. Pp. iv+204. Vol. No. 3 (July 14, 1943): Thomas Jefferson; Papers read before American Philosophical Society in celebration of the Bicentennia Thomas Jefferson, Third President of the Society, Annual Meet April 22, 23 and 24, 1943. Pp. iii+199–290+7 plates. (Philadelp American Philosophical Society.) [

Catalogue

A Catalogue of Books on a Variety of Subjects suitable for Prese tion together with a selection of New and Recent Books. (No. 6 Pp. 24. London: Bernard Quaritch, Ltd.) 1*d*.

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RESEARCH AND THE UNIVERSITIES IN RECONSTRUCTION

THE importance of scientific research as a basis for the industrial reconstruction, adjustment and developments which Great Britain must be prepared to make after the War has been repeatedly emphasized in recent months. Following on Sir Harold Hartley's appeal for industrialists to become more research-minded, Lord McGowan discussed the particular position of the chemical industry in an address before a joint meeting of the Institution of Chemical Engineers and the Chemical Engineering Group and the London Section of the Society of Chemical Industry. The report of a committee of the Federation of British Industries under the chairmanship of Sir William Larke, to which Dr. Dunsheath referred in his Atkinson Memorial Lecture to the Royal Society of Arts earlier this year, has now been published, following swiftly on another notable report from the Parliamentary and Scientific Committee.

The burden of this consensus of opinion is the imperative need of a very considerable expansion of scientific research, both within and without industry, if a policy of full employment is to be pursued, our material resources effectively and efficiently utilized in a rising standard of living and the essential export trade maintained, restored or expanded. On the extent or nature of that expansion there may well be differing opinions, and the reports in question and Lord McGowan's paper are concerned more or less deeply with the different aspects of the problems involved.

The expansion of the research effort in Great Britain involves a number of fundamental problems, both of policy and of tactics. First, there is the question of organization, and structure : Are the existing organizations of the right type, do they make effective use of the resources at their disposal and is the distribution of research effort over the whole field balanced ? Secondly, there are the questions concerned with the endowment of research and the best means of providing the essential financial support, and the magnitude of that support required. Thirdly, there are the problems involved in the supply of research workers and other scientific personnel, their training, remuneration, status and the like ; while fourthly, there are the questions concerned with the utilization of the results of research, involving the broad education of both industry in particular and the nation as a whole.

In the main, it may be said that the report of the Federation of British Industries is concerned with the second group of problems. Into the broader questions of the strategy of research, industrial or otherwise, it does not enter, and it passes rather superficially over the third group of problems concerning the supply and training of research workers. One of its principal recommendations, the establishment of a Bureau of Industrial Research, does indeed enter the field of organization and structure, but on that group of problems generally the report expresses satisfaction with the general scheme of organization at present existing, although critical of the policy of the Department of Scientific and Industrial Research as somewhat restrictive. On the other hand, the Committee is far less critical of the research associations than Lord McGowan was, and the general tenor of the report is in striking harmony with Sir Harold Hartley's pamphlet.

The report of the Parliamentary and Scientific Committee, however, on "Scientific Research and the Universities in Post-War Britain", has a freshness of outlook and a pertinence in relation to demobilization, post-war planning and educational reform which make it of first-class importance. In this respect the second part of the report, on the supply and training of research personnel, almost completely outshadows the first part on the need for increased research. The latter is an able re-statement of the case outlined by Sir Harold Hartley, though covering the whole field of scientific research, including agricultural and medical research as well as industrial, with a welcome emphasis on the need for biological research in all its branches.

While this statement is the nearest approach to a review of the whole front of research and a challenge for more balanced development and distribution, a question to which the Committee proposes to return in a future report, the second part of the report is an acute analysis of problems which have indeed been touched upon of late—for example, the House of Lords' debates on July 15 and 20—but have not received anything like the emphasis they merit. They hold as essential a place in any scheme for educational reform as they must do in any plans for demobilization.

To enable research work to be adapted and expanded to the peace-time requirements, there must be an equivalent adaptation and expansion of the present supply of scientific personnel. For this supply there are two sources: existing scientific workers released from temporary war-time employment, the Services and armament work, and trained, as necessary, for new peace-time research requirements; and increased output of science graduates from the universities and technical colleges. The sum which can be profitably expended on research is strictly limited by the number of inspired leaders and of trained workers available. The provision of sufficient numbers of the right men with the right training is the first essential in any extension of research.

It is obvious that such expansion of the supply of scientific personnel involves expansion at the universities and technical colleges, and an all-round improvement in the teaching of science and scientific principles at all stages of education for the whole school population of the country. First in urgency in the Committee's view is the need for the effective organization of the demobilization of the large number of scientific people now on war work or in the Services, to enable them to complete their training and to guide them into positions where their previous training and their war experience will be of special value. A systematic approach covering the whole of British industry is a matter of real urgency if we are to ensure that full use is made of the considerable reserve of scientific intelligence available in the technical branches of the Armed Forces and the Supply Departments. The Committee hopes that this will be adequately covered by the special Committee under Lord Hankey dealing with such matters, but emphasizes the necessity of considerable funds if the objective is to be realized without serious loss of time.

Owing to the foresight of Lord Hankey and the committee responsible for the preliminary training of the younger of these men, many of them have had substantial, though incomplete, university training in physics, chemistry, engineering, etc., though no in the biological subjects, and should be able to complete a broad course of education within one o two years. The Government has already recognized the importance of such men in the post-war effor and, as indicated in the White Paper on Educational Reconstruction, has initiated a scheme by which they will receive training grants on demobilization Others, however, such as those who have entered the Forces immediately on qualification, may well requir similar grants for refresher courses, as is well argue by Mr. E. S. Conway in "Post-War Employment"* Mr. Conway is concerned with the maintenance o high standards of professional qualification, and his suggestion that professionally trained and experienced ex-service men who, as a result of war service, hav lost touch with their work, should be allowed the right to qualify in a shorter period and at a lowe standard of attainment, providing they follow "post-completion course" over a period of year which would bring them up to a standard in advanc of that normally required but in a more specialize field selected by the individual concerned, deserve consideration by professional bodies as well as b Lord Hankey's committee.

This whole passage, with its warning against th intellectual stagnation that tended to creep into th professions between 1919 and 1939, owing to th lowering of standards, and, not least, its reminde that the healthiest incentive to research is a natura enthusiasm for the work, deserves the serious attention of all scientific workers. Some may well hold that Mr. Conway goes too far in the measures o compulsion he advocates. None the less, scientifi workers will neglect at their own peril this clea warning of dangers ahead.

The value of such measures in bringing our scientific resources in personnel to maximum efficienc cannot be denied, but for the training and provisio of research workers we must continue in the main to look to the universities. To deal with a rapi growth in the number of students of science an technology is one of the first reasons for the expansion of existing universities, and possibly the development of some existing institutions into universitie The Parliamentary and Scientific Committee, pointin out that we have more than doubled the output engineers and physicists during the War, estimate hat the universities of Britain will require to handle ltimately some two to three times the 1938–39 umber of students of science and technology in rder to meet the requirements of any thoroughoing post-war reorganization of research and techical development in respect of trained personnel, part from further developments foreshadowed in onnexion with science teaching in schools.

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* "Post-War Employment." By E. S. Conway. Pp. 142. (Londo Jonathan Cape, Ltd.) 8*s*. 6*d*. net.

Lord McGowan, in the address already mentioned, ubmitted that the main function of the universities to train and supply the community with the best ype of research worker, but if the post-war requireents are to be met quantitatively as well as qualitavely, the urgency of the problem cannot well be ver-stressed. The Parliamentary and Scientific ommittee regards a permanent increase in the udent population of Great Britain as a national ecessity. It is not too soon, it urges, to consider e requirements of 1950. Any such programme early involves the provision of academic staff as ell as buildings and equipment, and the necessary rovision must be made in good time. Taking first e question of staff, an increase in university staffs well as stipends is recommended. Men of ability ust be recruited as they are released from their resent posts, and the present low scale of university ipends must be revised if the right men are to be tracted and retained—a point which has been reiterted in the House of Lords debates and in Mr. Bruce ruscot's book "Redbrick University" and elsehere.

If the necessary staff is to be available to cope with e immediate post-war demands, the conclusion ems inescapable that there must be priority of emobilization for university teachers from Governent service. In this conclusion the Parliamentary d Scientific Committee appears to controvert the rinciples of demobilization already laid down by e Government. The principle of demobilization cording to length of service is, however, clearly of lue only as a general guide, and in this respect the port by implication emphasizes the necessity of orking out a really scientific scheme in which due rovision is made for the demobilization at the earliest ssible moment, irrespective of length of service, those workers who are essential to the progress the general measures of reconstruction. Unless is is done, we may well find that men anxious to -train or to complete their training at a university technical college are unable to do so because the achers required have not been released ; this state affairs would frustrate the policy of full employent from the start.

What is essential, however, is that this position d the exceptions that it may be necessary to make the length of service principle shall be fully and ficially explained in advance, and that full assurance given that the exceptions to be made are deterined solely by the public and general interest. here must be no room for any suspicion that private sectional interests are allowed to influence policy. hat point is well made both by the Sub-Committee the Conservative Party on Demobilization and e-settlement in its first interim report recommending a points scheme, and in a statement by the Tory Reform Committee. No plan for demobilization, however well devised, will succeed unless its nature and objects are fully understood by all concerned, and it must be explained to them now.

Besides staff, materials and finance must be made available for the expansion of research schools in the universities, and the Parliamentary and Scientific Committee estimates that a capital sum of £10,000,000 will be required for buildings and equipment, including libraries, spread over the first five post-war years, as well as adequate priority for the work and materials involved. In addition, the present annual Treasury grant to the universities of about £2,250,000 should be increased to six or seven millions.

The Committee assumes that the University Grants Committee will shortly be considering the immediate needs of the universities of Britain, both as to capital expenditure and income, to enable them adequately to carry out the vitally important duties which they will be called upon to undertake when demobilization begins. The Committee doubts, however, whether the University Grants Committee, as at present constituted, has either the powers or the machinery for initiating the major changes now required. Its present constitution excludes membership of those actually engaged in university work, and it is without any representatives of the 'users' either of university-trained personnel or of the results of university research. It can represent to the Treasury the case for expansion and recommend allocation of the funds available, but it lacks any power to consider University policy as a whole or to advise the creation of new chairs, new departments or new universities. No doubt these points will be considered in the re-organization of the University Grants Committee now contemplated (see NATURE, November 20, p. 595).

While the University Grants Committee is likely to consult industry and the professional institutions, and there is no reason to suppose that its findings will lack boldness, there is a strong case for some change in organization. The Parliamentary and Scientific Committee, like Lord McGowan, emphasizes the vital necessity of preserving the present freedom which the universities enjoy from control by the Board of Education or other Government Departments, but if the universities are to ensure the best use of the increased assistance from the State, or from industry, for which Lord McGowan pleads, some further means of co-operation with industry must be developed. The Parliamentary and Scientific Committee suggests accordingly that the universities should establish an effective advisory council which would be able to effect co-ordination and eliminate any unnecessary or wasteful overlapping.

Suggestions have from time to time been advanced that particular universities in Britain should concentrate on special fields of training. Mr. Bruce Truscot, for example, suggests that by inter-university arrangements most of the schools which have few or no students could be eliminated and the teaching concentrated where it best fits into the general programme. The financial gain would be considerable and the gain in general efficiency still more. The point is again made by the Parliamentary and Scientific Committee, which suggests that a general survey may well be needed to ensure efficiency all round.

In the unofficial Committee of Vice-Chancellors and Principals, British universities already possess the nucleus of a central advisory body which might discharge such responsibilities. The representation should include, however, the teaching staff of the universities and persons of distinction in industry, medicine, agriculture, education, the Government services, etc., in which university graduates are employed. A single body of this kind would be too large and unwieldy for efficient operation, and formation from it of a smaller university council, with sub-committees to deal with special interests, is suggested. Set up by the universities themselves in consultation with the other interests concerned, this council would in no way encroach on the essential freedom, diversity, integrity or independence of the universities. By ensuring that these essential privileges are not endangered by any charges of waste, inefficiency or confusion, it would provide the most effective answer to those who contend that there can be no substantial increase of university grants without introducing some measure of Government control.

An even closer analysis of this aspect of university finance is to be found in the report on university finance in Great Britain issued by the Committee on Post-War University Education of the British Association. This report is more complacent with regard to the University Grants Committee than is that of the Parliamentary and Scientific Committee, and no change in organization is suggested. The first step recommended is that the University Grants Committee should ask the universities to forecast their immediate requirements on the basis of 1938 prices and a fifty per cent increase in numbers. The question of control by the State is recognized, but the tribute to the past work of the University Grants Committee and the confidence that the universities will be strong enough to resist any harmful pressure which might be coupled with substantial increases in State grants are accompanied by a reminder that, while the universities safeguard their autonomy, they must overcome their fear of Government influence in university affairs.

On the whole, the British Association Committee's report, at least qualitatively, underlines the same points as that of the Parliamentary and Scientific Committee. It has less to say about research, but points to the increasing expense of the equipment required for that purpose, and comments on the inadequacy of many laboratories and the piecemeal and unbalanced development due to the frequent dependence on the whim of individuals and the immediate needs of the more enlightened industrial organizations and associations. Far more attention must be paid to the exploration of new fields of knowledge, and in particular the report suggests that the experience of the War and the numerous schemes under discussion for extending the application of science to the whole field of social and industri reconstruction should be decisive arguments in favou of greater State financial support of the maj university objectives. The importance of the co tribution which the universities of Great Britain ca make in training research workers is again emphasize in this connexion.

With regard to finance, the report considers th the universities must look in the immediate futu to State and local assistance for their major develo ment, and it is urged that the Treasury grant shou be at once doubled after the War. Local authoritie grants should also be increased. Most of these ha remained unchanged for some years, whereas rateab values have increased and the services of the unive sities to their localities have extended; but the may be some need for further change in universit organization if increase of such local grants is n to be accompanied by undesirable increase in loc control.

On the question of capital expenditure, the Britis Association Committee points out that this will be co fined chiefly to buildings, but it is pointed out that such needs would fit well into a public works sche designed to assist ordered demobilization, and, apa from some temporary building to provide lecture an laboratory space for the great influx of students imm diately after the War, would provide Great Britai with permanent assets well worth the expenditu A total expenditure of twenty-five million pounds visualized under this head. On maintenance, th report stresses revision of salaries, which should given priority over almost everything else and the essence of the situation. The salaries of bo lecturers and professors require revision, though different grounds, and the institution of an adequa supply of senior lectureships and readerships strongly urged, as well as an overhaul of the who question of superannuation.

So far we have discussed the situation mainly wi reference to the training of personnel for researc though it has been indicated that the plan for educa tional reconstruction proposed in the Government White Paper necessitates a considerable increase the existing number of teachers. A further Britis Association's Committee report puts the shortage more than 120,000 rather than the official estimate 70,000, and the majority of these will require university degree course followed by a two-yea training course afterwards. This is obviously important factor in determining the expansion of th universities, and also has a bearing on the trainin and supply of laboratory technicians, who are no le important in the development of research depar ments than the supply of research workers themselve The Parliamentary and Scientific Committee stress the importance of developing technical educatio and welcomes the assurance in the White Paper wi regard to the association of the technical colleges a art schools with the industrial and commercial li of the country. Experience, it is pointed out, sho that one graduate research worker can, on average, usefully employ at least three laborato technicians.

There is yet a further matter of vital importance to he supply of trained personnel. The Parliamentary nd Scientific Committee urges that State bursaries nd engineering cadetships should be continued fter the War ends, and developed to cover sciences ot hitherto included. Greater aid should be availble for young graduates who wish to continue tudies for a higher degree and who could at the same ime assist and gain useful experience in demontrating. In addition to generously implementing he recommendations of the Norwood Committee, he dearth of postgraduate scholarships and of postoctoral fellowships requires attention. The present nadequate grants of the Department of Scientific and ndustrial Research should be increased both in umber and in value, and the medical and agriculural sciences should similarly be provided for through he Medical and the Agricultural Research Councils. inally, larger assistance to young people in industry enable them to take full-time courses is essential we are to produce the men who have a fundamental nderstanding of processes as well as the much greater umber of those who know how to work the levers nd supervise the repairs.

This widespread measure of agreement on the eans by which Great Britain is to be assured of an dequate supply of trained personnel for all branches f scientific research follows on a growing recognition at the conditions of service in both industry and e universities must be such as to attract men of e highest quality. It received expression in the ouse of Lords debate and notably in Lord McGowan's eech then and his subsequent address already ted. It is recognized in the report of the Federaon of British Industries, which also advocates a ore general provision by industry of funds for llowships, bursaries and the like at universities nd technical colleges and schools. The report of e Parliamentary and Scientific Committee and ose of the British Association committee are calcuted powerfully to assist the task of educating public pinion to the necessity of early and effective action. he case could scarcely be put better. Even if we take e maximum amounts proposed—increase of the nual Treasury grant to the universities to six or ven million pounds and of £25,000,000 for capital xpenditure—the proposals are moderate in relation the issues involved or in comparison with, for xample, expenditure in the United States. Even ore clearly the need for immediate action is made anifest, and this action must form an integral part the plans and machinery for demobilization and the post-war building and public works schemes. ot only have those plans to be formulated; they ve also to be explained in advance.

The reports which have been referred to above dicate the ground to be covered and demonstrate nphatically the dangers of the Government's dilariness in taking its decisions and formulating policy er the whole field of reconstruction. They attest ce more that transition from war to peace economy ust be a continuous process, planned and ordered d explained in advance, if frustration and confusion e not once again to follow the cessation of hostilities.

THE WRITING OF ENGLISH

The Reader Over Your Shoulder

A Handbook for Writers of English Prose. By Robert Graves and Alan Hodge. Pp. 446. (London: Jonathan Cape, Ltd., 1943.) 18*s*. net.

MANNER of speaking or writing is often an indication of a person's mental make-up, and, as a modern writer has asserted, faults of style may reflect faults of character. At any rate in the world of to-day, ability to express oneself well in speech and script is a most useful quality; and it is a quality that can be taught to, and learnt by, most people, if they take the necessary pains. The trouble with most poor writers is that they are lazy: they lack the 'passion to excel' of the artist and the craftsman. The technical writer, in particular, is often so keen to communicate his knowledge, to 'get there', that he does not worry about style or method of presentation, and therefore is put down as an unlettered man; whereas by taking thought and a little trouble, he could greatly improve his style and 'put it over' far more satisfactorily.

Of the factors that make for good prose composition, perhaps the chief is having something to say; but that is run very close by being able to say it clearly, precisely and concisely. Clarity is fundamental, and it is achieved not only by thinking clearly, but also by knowing the exact meanings of words, by ability to choose the *mot juste*, and by the more technical procedure of arranging words, sentences and paragraphs in logical order. "Style is connexion", said Jowett, "art is putting things in their places". Balance and rhythm are also valuable qualities.

Messrs. Robert Graves and Alan Hodge, in their interesting book, assert that it is impossible to write perfect English, and even to write it well is difficult. Few will controvert this statement, especially those whose efforts to succeed have been made with toil and sweat and, perchance, with tears.

The rules of good writing apply equally well to authors of scientific and technical prose as to purely literary authors; but there is an important difference between the two kinds of writing. Both aim at imparting information, but the literary man relies to a considerable extent on emotive appeal, with which the scientific writer is not concerned; the latter's job is to make exact statements about facts and hypotheses. Not that some scientific writing is entirely without emotive appeal, for example, astronomy and biology, which often excite wonder, curiosity and humility, but that is usually quite a secondary consideration.

The book under review is divided into two parts. Part 1 deals with the peculiar qualities of English, its origin and its history; and then with twenty-five principles of clear statement and sixteen principles of the graces of prose. Part 2 consists of detailed criticisms of faulty passages from the writings of many eminent modern authors.

The peculiar qualities of English, which are due largely to its hybrid origin, include richness in words and metaphors, absence of gender and inflexions, interchangeability of certain parts of speech, wide choice of prefixes and suffixes, and wealth of prepositions, all tending to make it flexible and expressive of subtle shades of meaning. But they also make the language easy to abuse, and, together with its inconsistent spelling and pronunciation, make it difficult to learn.

As causes of the present confusion of English prose, the authors postulate haste, distraction and dividedness of mind, timidity and modesty. The ragged conversational style used by prominent people, they say, would in the 'eighties have been attributed to drink, mental decay, or vicious upbringing! This circumstance and the habit of dictating to a typist are responsible for much clumsy composition. Dividedness of mind and timidity are characteristics of 'official' English, including that of Cabinet Ministers who do not see eye-to-eye with their colleagues, that of priests who are assailed by honest doubt, and that of Communists uneasily following the party-line.

Where is good English to be found? they ask. Not among those who might be expected to write well professionally, such as schoolmasters, the clergy, men of letters, and trained journalists; but rather among those without literary pretensions who have responsible executive jobs in which the use of official English is not compulsory. Official English comes under the authors' ban, but they plead justification of it for use in framing Bills and Regulations, for these have to pass currency in courts of law.

Chapters follow on the beginnings of English prose, on the ornate and plain styles, and on the various kinds of prose—classical, romantic and recent. Then come the principles of clear statement and of the graces of prose, which are too numerous to be detailed here; it must suffice to single out a few.

There should never be any doubt concerning the 'who', the 'what', the 'when', the 'where', the 'how much', the 'how many', and the 'how long'. (The authors are especially critical of the ambiguous use of 'we'.) Every unfamiliar concept should be clearly defined, and neither discussed as if the reader knew all about it nor stylistically disguised. No unintentional contrast between two ideas should be allowed to suggest itself. (Example: "On entering the Guildhall, Mr. Lloyd George was enthusiastically cheered, while Lord Oxford was accorded a great ovation".) Critical readers of scientific and technical literature are well aware of the misuse and more often the complete omission of hyphens (the latter largely through laziness). The object of hyphens is to make the sense clear and the reading easy. In the authors' example: "In the Southern States slave-owners of property were expected to give their masters a proportion of its yield", slave-owners should be 'slave owners', that is, slaves who were owners of property. Punctuation should be consistent and denote quality of connexion rather than length of pause. Over-emphasis of the illogical sort tolerated in conversation should be avoided. Example: "That food is more important in the preservation of health than housing was shown by the late Dr. M'Gonigle at B——, but this is by no means to say that housing is not of the first importance". Authors' comment: "If food is more important than housing, housing cannot be of the first importance".

The principles of graceful writing relate to sensibility rather than to sense; three of them are concerned with metaphors. These should not be mismated; or piled on top of one another; or used in too close association with unmetaphorical language (for example, "Kay Rimmer sat with her head in her hands and her eyes on the floor"). The descriptive title of a person or thing should not be varied merely for the sake of elegance.

A fault that is frequently found in scientific papers, as well as elsewhere, is to repeat the same word too often in the same sentence or paragraph. The authors give these examples *inter alia*: "There has been . . an honest dread on the part of many of the popularization of a form of godliness that lacked its power of the substitution of an emotional appeal at the fireside for the organized fellowship . . ." Similarly with the preposition 'in': "In fact, in countless villages in England in this war and in a variety of ways, there has been a most astonishing adaptation of local products to war needs". Another blemish is to place too close together words which rhyme or form a jingle: "The need of registration or re-registration at this station of all workers on probation is to be the subject of examination by the Administration' —perhaps rather an extreme example. The comparative and superlative of adjectives are sometime used where there is no degree of comparison; fo example, "The new inquisitions are more omnipresent than the old". There are no degrees o omnipresence. Over-emphasis by the illegitimate us of adverbs like 'infinitely' and 'immeasurably' is also to be avoided: "Buildings . . . have been physically knocked down". It would be difficult to knock them down mentally or morally. Irrelevancy and verbosity are common characteristics, more especially at scientific meetings, where such statements as "There is another observation I would like to make befor I pass on", and "We must use our best endeavours (that is, try hard) are frequently heard. In his "Scienc and the Modern World", Prof. Whitehead wrote: "The inevitableness of destiny can only be illustrated in terms of human life by incidents which in fac involve unhappiness". Since, say the authors, destiny is by definition inevitable, the sentence can be reduce to "Human destiny can be exemplified only wit unhappy instances".

These numerous principles (which in their wealt of negative injunctions remind one of the Decalogue are then used as criteria to assess the literary valu of many passages from modern literature; and mainly with destructive effect. Politicians, novelist literary critics, journalists, economists, soldier sailors, philosophers and men of science, all ar 'hauled over the coals' for transgressing one or mor of them. Many of the criticisms are, in the reviewer opinion, 'pernickety'; the passages quoted are in most cases clear enough in meaning, and if one set out to write, bearing in mind all the author numerous 'don'ts', one would not get very far: th product would be 'sticky' and lack spirit. On th other hand, it must be admitted that almost withou exception the 'fair copies' given by the authors ar superior to the originals: they are clearer, mor exact, and frequently more concise. A few example taken from scientific literature must suffice.

Sir Arthur Eddington, in "The Expanding Un verse" (1932), wrote: "The position with regard t the thermodynamical running-down of the univers has not materially altered since I discussed it for years ago". The authors say that, literally, th means that the universe has not run down muc during the past four years! Their fair copy runs "My theory, published four years ago, about th thermodynamical running down of the universe ha not since been seriously questioned". Althoug circumlocutions, like 'the position with regard to were placed on the Index Expurgatorius by S Quiller Couch many years ago, and the author version is shorter, very few readers would interpr the passage in the extreme way suggested by them On the other hand, few will controvert their remar that ". . . the theory of cosmic rays is being urged in this connection . . ." is a cumbersome way of saying "the theory of cosmic rays mentioned".

Dr. Julian Huxley is reprimanded for having written ". . . the economic and social forces have taken the bit in their teeth and threaten to pull the fabric of civilization down if not harnessed and conrolled". The authors point out that an animal which takes the bit between its teeth and threatens o pull down the fabric of a building must be already harnessed to it; and that it is difficult to imagine a context in which horses or mules taking the bit in their teeth threaten to pull down the fabric of a building. The fair copy runs ". . . forces generated by the interaction of new economic, industrial, military and other systems may now disrupt civilizaion".

Sir James Jeans is taken to task some sixteen times for various alleged minor offences in a passage of about 150 words taken from his "The Stars and heir Courses" (1931). *Inter alia*, he is accused of unnecessary repetition and of disguising it by contant variation of language. According to the authors, "nearly all scientists, at the point where they turn rom mathematical or chemical language to English, eem to be relieved of any further obligation to precise terminology": a statement that is probably meant to refer to popular scientific writing.

It would be wrong to infer that the authors show ny particular bias against scientific authors. They o not. They level their shafts indiscriminately gainst all writers who, in moments of temptation or berration, sin against the light emanating from their orty-one commandments. Everyone who wishes to rite well has something to learn from a perusal of his interesting book, whether he be a literary man, man of science, or a common scribe.

E. H. Tripp.

RESOURCES OF THE SEA

he Fish Gate

y Michael Graham. Pp. 196+16 plates. (London: Faber and Faber, Ltd., 1943.) 10*s*. 6*d*. net.

N the great experiments which made Robert Boyle the 'father of chemistry', we find him saying, very now and then, that his purpose was "the mprovement of Knowledge, and not of Trade", or ther words to that effect; for he knew that "both cholars and Gentlemen are wont to look upon the nquiry into Manufactures as a *Mechanick* employment, and consequently below them". After two undred and fifty years we have changed our minds, nd come to see that science must pay its way, and tand or fall, like all other occupations, by the measure of its usefulness to mankind. It has been omewhat hard to learn this lesson, and to trim our ourse to the new concept of 'science'; but we have plain example in the study of the sea, where many ciences meet together, and do so (if you only leave hem alone) to the benefit of all who do their business the great waters. How this happens is told by Michael Graham in "The Fish Gate", with ample nowledge, industrial and scientific, of the fisheries, ith many beautiful illustrations, and with a literary aste and skill which touch art, from the title-page the end of the book.

The industrial revolution has swept our old fishermen and their boats away; there is not one left in the little towns, like my St. Andrews, where I remember the busy harbour, and the women baiting the lines or mending the nets before their doors. "There are still the small owners", says Michael Graham; but he means the men who "own two or three vessels, which cost about £4,500 apiece when new". It is this modern industry which the author knows by heart which fascinates him, and he describes it to the very life: the pontoon at Grimsby where 500 tons are landed every day, and dispatched to two thousand destinations; the big Hull trawlers following the cod all the way to Novaya Zemlya, making a £2,000 catch in a few hours' fishing, and coming home with their holds half-full lest the market be glutted; the steam-drifters at Smith's Knoll in October, their skippers feeling their way with the echo-sounder, and the sea aboil with the 'swim' of herring, which love the merry moonlight as they have always done.

In these great modern fisheries the catch kept rising, even by leaps and bounds, until a day came when it rose no more. The North Sea alone was yielding 430,000 tons of fish a year thirty years ago—an almost fantastic quantity; twenty years later, with enlarged fleets, more powerful boats, more costly gear, and even a smaller mesh, the annual landings were just *a little less* than before. In short, when the story has been told of enterprise and expansion, of capital invested and fortunes made, there comes the inevitable reaction, a diminution of profits and an undeniable scarcity of fish. Some form of control becomes imperatively necessary, difficult as it may be to enforce it, and yet leave men content and secure. As a first but very considerable beginning, Michael Graham welcomes and applauds the Convention of 1937, which took formal steps towards international regulation of the trawl-mesh; it seems so obvious that if you would have the full-grown fish you must let the little ones go free!

But fish are not like ourselves. The case is not so simple when you deal with creatures which lay a million eggs in order that (normally) one pair may survive and take the places of their parents in the sea; when Nature herself thus slaughters the innocents; and when we know that small plaice and haddock are still plentiful in spite of everything, while the big are all gone and even the middle-sized are scarce indeed. Michael Graham is always candid, and, much as he praises the mesh-regulations, he is ready to concede that they will not suffice of themselves; for sooner or later there must come a self-denying limitation of the actual catch of fish. The coastal waters of the North Pacific teemed with halibut, and the fishery seemed inexhaustible less than forty years ago; but it proved to be nothing of the kind, and presently found itself on the road to ruin. Now a bold and drastic curtailment of the total catch has given a new lease of life to the industry. There is no exception to what Michael Graham calls "the Great Law of Fishing", that *fisheries which are unlimited become unprofitable!* But he has faith and confidence enough to turn the phrase the other way, and say that *limiting the effort will restore profit to a fishery.*

The author touches on every aspect of the fisheries, even, though lightly, on the cookery of fish. But when he tells us that we should fry our cod and boil our herrings, I begin at last to differ from him.

D'Arcy W. Thompson.

Annual Reports on the Progress of Chemistry for 1942

Vol. 39. Pp. xxviii+257. (London: Chemical Society, 1943.) 15*s*.

SINCE it is no longer profitable to attempt to review progress along the whole chemical 'front' in a volume which is meant to be read, these annual reports have been deliberately restricted in scope, whereby surely their appeal has been widened. Each year a number of important topics are selected for detailed discussion, so that representative pictures of progress in various fields of investigation are presented as a kind of 'album'. Paper shortage has on this occasion prevented inclusion of sections on analytical chemistry and on radioactivity and sub-atomic phenomena; but general and physical chemistry, inorganic chemistry, crystallography, organic chemistry and biochemistry are well represented.

G. Gee discusses the physical chemistry of rubber solutions; C. E. H. Bawn deals with the atomic reactions of the alkali metals; and W. F. Berg examines the physical chemistry of latent-image formation in gelatin – silver halide emulsions. H. J. Emeléus's brief review of progress in inorganic chemistry is based on general interest rather than on specialist value. A. L. G. Rees follows with an account of the luminescence of inorganic solids, and A. J. E. Welch illustrates some applications of modern technique in inorganic chemistry. J. M. Robertson's report on crystallography relates to the technique of structure analysis as well as to recent data for certain inorganic and organic structures. Organic chemistry is represented by the following subjects: stereochemistry (M. P. Balfe and J. Kenyon), general methods (F. S. Spring), the lignin problem (E. G. V. Percival), polycyclic aromatic compounds (J. W. Cook) and heterocyclic compounds (T. S. Stevens). Biochemistry is not on this occasion represented by the vitamins; instead, L. J. Harris discusses nutrition with special reference to trace elements, C. G. Anderson reviews the more outstanding developments since 1940 in immunochemistry, J. L. Cranmer and A. Neuberger briefly summarize recent advances relating to the proteolytic enzymes, and F. W. Norris gives an account of recent work on some plant products and enzymes.

Topographical Anatomy of the Dog

By Dr. O. Charnock Bradley. Revised by Prof. Tom Grahame. Fourth edition. Pp. xii+316+9 plates. (Edinburgh and London: Oliver and Boyd, Ltd., 1943.) 28*s*. net.

THE contents of this standard book are so well known and clearly indicated in the title that it is not necessary to review them. This edition has been revised by Prof. Tom Grahame and, while the bulk of it remains the same, there has been a certain amount of revision and three noteworthy alterations. First, after the descriptions of most of the muscles, a brief note on the function of each has been appended. Secondly, the number of illustrations has increased from 91 to 128 plus a frontispiece. The frontispiece is that of the skeleton of the dog, the majority of the new text-figures are of bones to illustrate the position of the origins and insertions of the muscles, and the last, accompanied by about three pages of description, is to illustrate the superficial lymph vessels and nodes. Thirdly, the new edition contains nine radiographs well reproduced upon plates. These three additions add materially to the usefulness of the book from the student's point of view. There i perhaps one criticism that can be made of the radiographs and that is, seeing it is the student's firs introduction to these valuable aids, they might b more fully labelled and explained in the accompanying legends.

The whole book reflects considerable credit o editor and producer alike, and, while primaril intended for the veterinarian, it will be found mos useful to anyone interested in comparative anatomy

An Easy Outline of Astronomy

By Dr. M. Davidson. (Thinker's Library, No. 95. Pp. iv+108+2 plates. (London: Watts and Co. Ltd., 1943.) 2*s*. 6*d*. net.

WITH astonishing versatility the Rev. Dr. M Davidson turns from philosophy to give u this little volume on general astronomy. The reade who has no previous acquaintance with the subjec can master the book without mental indigestion, an will leave it with a working knowledge of the element of descriptive astronomy. The author gives an up-to-date account of our knowledge of the movements dimensions, masses and compositions of the heavenl bodies without dealing with the identification of th constellations and individual stars. A few erro have been noted: among those which the studen will find most puzzling are contradictory statement (pp. 55, 56) on the proportion of comets with retrograde motion, and a loose construction (p. 31) whic makes it appear that solar eclipses which are no total are annular. In a section (p. 68) dealing wit the transformation of mass into radiation, D Davidson is betrayed into assuring his readers tha "when we burn a piece of coal, the weight of its ash and the smoke emitted is very nearly the same a the original weight of the coal"—surely a statemen that would make Lavoisier turn in his grave! B these are minor points which do not detract serious from the merits of this authoritative presentatio of the salient facts of astronomy in a form suited t the complete novice. A. H.

Beyond the Microscope

Being an Account of a Voyage of Discovery in th Borderland Country between the 'Living' Organis and the 'Non-living' Chemical. By Kenneth M Smith. (Pelican Books, A.119.) Pp. 12+4 plate (Harmondsworth and New York: Penguin Book Ltd., 1943.) 9*d*. net.

THIS volume covers the whole sphere of vir diseases in plants and animals and their investigation. The structure of viruses is discuss and illustrated by photographs taken by means the electron microscope. Among the chapter hea ings are "Viruses and Tumours" and "Combati the Viruses". The scope is remarkably wide, b the presentation is clear and the book makes mo interesting reading.

Human Physiology

By Kenneth Walker. (Pelican Books, A.102.) P 128+2 plates. (Harmondsworth and New Yor Penguin Books, Ltd., 1943.) 9*d*. net.

THIS is an elementary account of human physi logy for the layman written in simple langua and essentially concerned with the bearing of physi logy on health. Line drawings in the text follow th time-honoured tradition that no book on physiolo should be well illustrated.

THE ROYAL SOCIETY AND ITS HOMES*

By SIR HENRY DALE, G.B.E., PRES.R.S.

THE interest of the Crown in the Royal Society, and perhaps a recognition of a duty to provide commodation for it, were signified by King Charles I's grant of Chelsea College and its estates, as set rth in our third Charter of 1669. The property roved, alas, for various reasons, to be much more burden than an asset, and Christopher Wren, in 382, with the Council's approval and recorded ratitude, sold it back to the King for £1,300. Mean-hile, an opportunity for the Society to acquire a ouse of its own, built to the designs of Hooke and ren, on a piece of land granted by Henry Howard om the grounds of Arundel House, had not become fective. The Society, therefore, remained for fifty ears from its foundation a tenant of rooms in resham College, until in 1710, when Isaac Newton as president, it acquired the house in Crane Court, f Fleet Street, which was its home for another xty-eight years. In 1778, thanks to the personal terest in our affairs of King George III, the friend our great president of those days, Sir Joseph Banks, e Society was granted quarters in Somerset House. herewith the obligation of the State to provide us th housing was for the first time definitely accepted, n generous recognition by the Sovereign of the rvices which science had rendered to the state", as anks stated in his address of 1780. The records show at the accommodation in Somerset House was garded from the first as inadequate, even though r requirements had been reduced by the transfer our "Repository of Rarities" to the British useum. The rooms, on the other hand, can be seen om prints of the period to have had a pleasant gnity, and the Society remained in them for nearly ghty years.

Towards the middle of the nineteenth century, a ovement arose to secure new and better accommo-tion for the Royal Society, and at the same time for e other principal scientific societies then existing the Linnæan, Geological, Astronomical and Chemi-l Societies. So early as 1847 a memorandum was esented to the Council by the newly founded ilosophical Club, a more seriously minded secession om, or rival to, the Royal Society Club of those ys, formed under the same influences as those ich had just carried the revised method of electing r fellows. The Club presented proposals for bringing major scientific societies under one roof, centraliz- and co-ordinating their libraries without any empt at fusion, providing three or four meeting oms of different sizes, for use by the societies in nmon and in turn, and, in general, making better ovision for the interests common to all without any pairment of their independence in rules, traditions, ocedures or property. When those of us who have en considering present-day needs look at this morandum, presented in 1852, we cannot but mire the foresight and wisdom of our mid-Victorian edecessors.

An opportunity of housing the scientific societies us, as a community of co-operative but substantially ependent units, was actually presented in the same ar, 1852, by the offer of accommodation in new buildings then being planned on the estate at Kensington Gore, acquired with the proceeds of the 1851 Exhibition. We begin to see the benevolent interest of the Prince Consort in our concerns. Kensington Gore, we must remember, in those days of horse transport, was still on the rural margin of the suburbs; and, in gratefully declining the offer, the Royal Society and its associates urged upon the Government the desirability of housing the scientific societies centrally and, if possible, under a single roof. The acquisition by the Government, some years earlier, of Burlington House and its grounds, extending from the Piccadilly frontage through to the street which is now named Burlington Gardens, seemed, indeed, to have provided the ideal opportunity for giving effect to such a plan.

The Prince Consort, with a vision of the future meaning of science far in advance of his time, privately urged the five scientific societies to press their claim to the site. It had been understood, indeed, that the primary intention of the Government in buying Burlington House had been to provide accommodation for the learned societies. Lord Wrottesley, then president of the Royal Society, personally canvassed the Government, making it clear "that the desire of the chartered societies for juxtaposition and for the Burlington House site was unabated". Failing that, he indicated, they would be glad to be lodged in the buildings then occupied by the Royal Academy, that is, in what is now the National Gallery. The danger of a rival claim had become clear, and had, indeed, been mentioned to the Royal Society by the Prince Consort. It appears that the Government had already made some kind of commitment to the Royal Academy, so far as the mansion of Burlington House was concerned. It would take much too long to discuss even what is known of the rival lobbyings of those days. It must suffice for this occasion to recall the results, and to lament the fact that a magnificent opportunity was lost, which would have given London a scientific centre worthy of the nation's achievement. We cannot blame our predecessors, who probably did all that was possible; nor can we grudge their success to our friends of the Royal Academy, who are in no way to blame for taking what was offered to them.

If the Government, indeed, had then used Burlington House and its grounds to discharge only these two of the obligations to which it was to some degree committed, the needs both of the scientific societies and of the Royal Academy could still have been handsomely met, and adequate scope for future development could have been ensured to both. The mansion itself with the wings of the front courtyard, already scheduled for rebuilding, could, for example, have been allotted to one, while the other of the two claimants could have had a new building, with frontage at the north end of the gardens, and ample space for extension southwards over them, to meet increasing needs and new developments. The Government, however, used Burlington House first to satisfy a third obligation which it had accepted, to house the University of London, then only a degree-giving body requiring space chiefly for the periodical examination of large numbers of candidates. In 1858,

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From the presidential address to the Royal Society delivered on ember 30.

the continued pressure of the scientific societies and the Government's own desire to recover the rooms in Somerset House led to the offer of the use of Burlington House to the Royal Society, subject to the condition that for the time, and pending rebuilding on the sites round this courtyard, the Linnæan and Chemical Societies should be accommodated with us in the mansion, and that the University of London should still be able to use the large rooms in it for examinations. It is curious to reflect that this temporary arrangement gave to the Royal Society and its associates their only opportunity to this day, even to share the use of a room suitable for a meeting of more than very modest dimensions.

In old Burlington House, then, we were established, and were to remain there with the Chemical and Linnæan Societies for some fifteen years; and an appearance of stability had at first been given to our occupancy by the mention of plans to build a new examination hall for the University of London on the western side of this quadrangle, and to allow the Royal Society to use this also for large meetings and for its gallery of portraits. Two later developments, however, dispelled any such hopes. In 1867 evidence came to the Society, first through a statement in *The Times*, that the Government had decided, after all, to give the Royal Academy a permanent lease of Burlington House and the right to extend northwards by building over its gardens. At about the same time, and presumably in fulfilment of another commitment, the large building which now fronts on to Burlington Gardens was begun, to accommodate the University of London and its examinations, and was opened by Queen Victoria in 1870.

The scientific societies were not, indeed, to be homeless; but the only possibility now left was to accommodate them in the buildings planned to be erected round this front courtyard, where they have been ever since. The total space thus offered did, indeed, allow more room to each of the societies than it had previously enjoyed, even after the Society of Antiquaries, at the Royal Society's instance, had been included in the scheme. But the space now available could not easily be planned for the sharing of meeting rooms and general facilities, or for a central federation of the libraries, or for any of the features of the earlier plan which would have enabled the societies to function as independent members of a real scientific community. The scheme had an even more fatal defect. The plans were made on the assumption that the societies existing in the 1860's, with their respective dimensions and requirements at that date, would provide a pattern of the needs of science for all time, or at least for the life of buildings designed to mid-Victorian standards of permanence. Each of these societies, therefore, with the approval of the Royal Society we must admit, presented its separate claim and had it embodied in the solidity of the buildings we still inhabit, filling the available space completely and precluding any later expansion, rearrangement, or new admission to the circle thus finally closed. Societies which have changed but little in numbers or activities may have had little reason, even yet, to complain of the accommodation which they acquired. For others, the allotment which had been regarded then as satisfying future needs for half a century at least became obviously inadequate very much earlier.

In 1900 came news that the large building on the Burlington Gardens frontage was to be vacated by the University of London, and tentative inquiry was immediately made as to the possibility of allotting to the Royal Society, on the ground that "the prese rooms occupied by the Society were rapidly becomi inadequate". The Government, however, had alrea decided to transfer the building to the Civil Servi Commissioners, and it has continued to be dedicat to its original use for large-scale examinations, sa for the later assignment of certain rooms in it to o much younger sister, the British Academy. It w be noted that the Royal Society was finding i quarters here inadequate so early as 1900, twent seven years after it entered them, and before the was even any prospect of the great expansion of i responsibilities and activities in recent years. O accommodation is still the same to-day, after seven years. Our walls cannot find room to hang o important collection of scientific portraits, and o great library is badly overcrowded, even though have parted with some of it to give better housin for a time, to the remainder; and it continues, course, to grow. Library pressure, in fact, is felt varying degrees by all the societies here; and I thi that it is still true, as some of our predecessors s already in the 1850's, that no scheme will be able deal with this problem efficiently, and to meet mode needs without disturbing historic associations, whi does not include some kind of central co-ordinati of libraries. The lack of a lecture or confere room, available in common for larger meetin and well equipped with modern resources for p jection and demonstration, is another acutely f need.

There are greater needs and anomalies, howev than any of these common ones. Of all the societies Burlington House the Chemical Society, which w originally satisfied with the poorest allotment of roo has undergone the greatest expansion. In the 1860' had a membership of some 450; it now has ab 5,000. Its library, of great importance to all work in chemistry, whether fundamental or applied, has burst the bounds of its accommodation, that a p of it is deposited in the crypt of a neighbour church; and the Chemical Society's meeting roo in every way unsuitable, and inadequate to meanest conception of the regular needs of a soci of its standing and numbers. Apparently our p decessors of the 1870's did not see much future chemistry. On the same evidence, they did foresee any future for physics at all. The Physi Society did not then exist; by the time it was bo there was no room for its admission, and the St has never offered it a home. The same is true other societies formed later to deal with functio aspects of biology and other new fields of knowled For most of their meetings these newer societies and need the facilities available in academic a research institutions. A national centre of scie however, should be capable of progressive adjustm to changing needs, and we ought to be able to m new admissions, on a varying scale of allotment, the central community of societies.

What then should we be doing to deal with situation? Actions and decisions long past h imposed it upon us, and regrets and repinings o an opportunity lost more than seventy years ago not help us to-day. We must admit, too, that present quarters, with all their defects of elastic have provided a combination of central position w freedom from noise of traffic which might be har find again. Let me say, then, that the Royal Societ officers, having consulted with the officers of ot societies here, and particularly of those whose needs are urgent or whose interests might be directly concerned, have not yet abandoned the attempt to find a solution which would not involve the removal of any from the Burlington House estate. If we fail in that direction—and there is no ground for optimism—the problem will remain, and the time is not one for neglect or postponement of action.

On all hands we hear talk of reconstruction and see plans for the rebuilding of London. We cannot expect another Christopher Wren—one of our original fellows and a leader in the science of his day; London missed that opportunity. It is natural and proper for the plans now being presented to make spacious and impressive provision in the new London for opera, drama, music and all the fine arts; and we shall surely join in a general welcome to any practicable scheme which can open the doors more widely to such cultural privileges, and enhance their dignity and worth in the eyes of London and of the nation. But I do not think that we must stand by and allow the claims of science again to go by default. A fear of over-statement, a passion for critical accuracy which is a part of the very spirit of science, may make us reluctant advocates. If necessary, however, we must be ready to remind all who may be concerned of the part which the British scientific effort has played, in making it possible now to plan at all, with confidence, for our own civic and national reconstruction. But for science, we may remind them, the very different plans which our enemies were so recently making for our future might already be taking effect. I have no doubt that the claim will be handsomely admitted; but we ought not to be too easily appeased with compliments and oratorical bouquets. The nation's opportunity, when peace returns, of enjoying the arts and the amenities of life will be dependent on its standards of health and prosperity, and these, in turn, ever more directly on science and its applications, as certainly as these are still needed to secure our national survival and victory in this War.

This ancient Royal Society of London, and those societies which have grown from it and around it in later years, constitute a scientific organism which is a national and imperial heritage, second to none in the world's esteem. Here are the roots of the spreading tree of science and technology, which should form a major component of our national contribution to the new world now in the making. Seventy years ago these roots were given only enough soil for the replanting then undertaken; they have long been badly pot-bound, and some parts of the root system are threatened with strangulation, while others have appeared outside the pot. We can properly claim, I think, that the progressive needs of our scientific societies shall be given early consideration, in any new allotment which plans for reconstruction may allow. We ought to have a scientific centre permitting them to co-ordinate their activities with economy, and giving room for change, expansion and organic growth by budding and division, in accordance with Nature's law. I think that we have the further right to expect that the home of science, in this capital city, will have a dignity symbolizing its value to the nation and the empire, and enabling us to hold up our heads in the company of other countries, whose scientific academies, not more famous than ours, have so long been housed more worthily, and with a more generous recognition of their due place in an enlightened people's scale of cultural values.

THE COMING OF PLYWOOD

A REVOLUTION IN THE UTILIZATION OF TIMBER

THE return to wood in the construction of certain types of aeroplane has given rise to some new factors in the future utilization, or perhaps more correctly expressed, in modifications in the utilization of the remaining timber supplies of the world. Generally speaking, the most important property in materials used in the construction of aeroplane structures is great strength combined with lightness. As a result of research in India (vid. *Ind. For. Records.* "Indian Timbers for Aircraft and Gliders". Delhi: Manager of Pub., 1942) the strength to weight ratios for several materials are as follows: material, Sitka spruce, M. of R./sp. gr., 25,500; Douglas fir, 24,000: Indian spruce, 26,000; Indian fir, 25,900; ash, 25,800; teak, 24,800; *Michelia excelsa*, 25,100; *Polyalthia fragrans*, 21,300; *Phoebe goalparensis*, 22,600; *Canarium euphyllum*, 22,400; duralumin, 21,300; carbon steel, ordinary, 12,700; nickel-chrome steel tempered, 23,600.

These figures at once give the reason for the pre-eminence of spruce in aircraft construction in Europe and America. Weight for weight, it is stronger than the best alloy steel and much superior to duralumin, of which a great many metal aircraft are constructed. Owing to its low specific gravity, timber is also suitable for long members subject to buckling or combined binding and compression. In such cases it is said to be generally easier to increase considerably the moment of inertia of a timber section by simple processes than is possible with metal members without increasing the weight. It may be briefly mentioned that timber is used in aircraft construction in the wings, body-work, tail, airscrews, and the covering of the framework. For the main members, such as the spars which support the wings, the longerons which support the body framework, and the tail members, only faultless timber of the highest quality is accepted. For these parts and other members of the framework, selected Sitka spruce is usually used. Wooden airscrews are mostly of walnut and mahogany. In the covering of the wing surfaces and body frames plywood is used, selected birch being one of the best woods. The construction of gliders is similar to that of aeroplanes, and requires the same consideration of strength and weight. It thus becomes evident that very strict specifications must evidently be in force, and only timber of the highest quality will be accepted for aircraft construction. But a high proportion of this material is required in short lengths only.

In connexion with plywood generally, a "Note on the Manufacture of Plywood in India" (*Ind. For. Rec.*, Utilis., Res. Inst. Delhi: Manager of Pub., 1942) gives information on the prospects of the industry, on existing plywood mills in the country, on possible areas for exploitation, on glues and the manufacture of plywood and tea boxes. It also discusses the machinery required for a plywood mill and the manufacturing costs. A list of timbers considered suitable for plywood work in India is also given. Plywood research is not new to the Research Institute at Dehra Dun. For many years since its inauguration this research was carried out by Mr. W. Nagle, the officer in charge of the Wood-working Section. He retired in 1940, the memorandum in question being written by S. W. Kapur, who has had the additional advantage of having studied Japanese methods of plywood manufacture.

The question of veneers, the foundation of plywood, is dealt with in another publication (*Ind. For. Leaflet* No. 34. Dehra Dun, U.P.: For. Res. Inst., 1943) entitled "Types of Seasoning Kilns suitable for Drying Indian Woods", already referred to in NATURE. On these questions of seasoning veneers the following is of importance: "Thorough seasoning of veneers before gluing and manufacture into plywood is very important, if satisfactory plywood is to be made. Green veneers can be air-seasoned or kiln-dried exactly like ordinary wood. The usual method in Europe and America, for the quick seasoning of veneers, is to dry them in long progressive dryers. These dryers are closed metal chambers 50 ft. to 100 ft. long, fitted with powerful fans for the rapid circulation of air, and with steam-heated pipes for raising the temperature of the air circulating inside the dryer. The green veneers are fed into one end of the drying chamber and slowly moved towards the other end by means of endless belts or between rollers fixed along the length of the dryer. The speed at which the veneers move can be controlled, but they are usually dried in the course of a few minutes which they take to travel from one end of the dryer to the other. Unfortunately progressive dryers are very costly."

It is pointed out, however, that the above type of dryer is not essential for the quick seasoning of veneers, and it is possible to use certain other types of cheaper kilns.

Under the title "The Forest Giant goes to War" (*Christian Science Monitor*, January 9, 1943) details are given of the heavy fellings being made in forests in the United States. The following extract portrays an increasingly serious position. "Even within the Douglas fir region itself, where the facts are at hand, there are forebodings that the tide of war demands for 'the most critical species of lumber in the United States' will leave a wake of wholesale destruction in this incomparable resource. The production of what the trade terms 'West Coast lumber' from the region of 1941 was 8,500,000,000 feet. This was principally Douglas fir, but also included its companion species —West Coast hemlock, Sitka spruce, and Western red cedar. In 1942, production was running about 3 per cent ahead of 1941, despite severe shortages in manpower and equipment. The annual war-time cut is thus roughly 1½ per cent of the region's stand of all species of sawtimber. One fact of importance on this figure is that the choicest grades of timber, such as airplane spruce and 'peeler' Douglas fir, are being overcut. Certain areas also are being overcut, particularly the forests that remain close to tide-water and to rail outlets."

Plywood has now become one of the chief factors in timber utilization. This new factor may be well termed revolutionary in its future possibilities, coupled with the modern plywood mill or factory. In professional circles the latter was regarded as more or less of a Cinderella before the outbreak of war, and only the few visualized it as one of the chief methods of utilizing timber in the future. War developments would seem to have proved this without any reasonable doubts. How will this benefit mankind? It is not difficult to frame an estimate. The exploitation of the primeval forests of the globe, both conifers and broad-leaved, have in the past left much to be desired, the waste in conversion, both in the forest and the sawmill, having been excessive. The forest war fellings are accentuating this deplorable wastage. In the past, in the tropical forests consisting of a large number of species growing in mixture of which so far but a few have had any marketable value, and only one or two of these a world value, the waste in extraction of these latter, owing to the excessively high specifications laid down by the buyer, has been enormous. Great logs with slight external flaws in them and giant butts which would not fulfil the buyer's terms were left to rot in the forest—material of a priceless value. Outside the forest has lain in wait the sawmill. These latter have been vastly improved during the past half-century—but it has not proved possible to eliminate a considerable waste in conversion, especially in sawdust. It is being demonstrated that the modern plywood mill has reduced the waste of timber, the raw product, to a very low percentage. So far as the remaining hardwood forests of the world are concerned, tropical and otherwise, plywood utilization would seem to indicate that their economic life (that is, utilization) can be prolonged, if not indefinitely, at least for a far longer period. For one thing, by means of plywood a larger number of previously unutilizable species in the great rain and deciduous tropical forests will become commercially practicable; while the appalling waste in the conversion of the so-called luxury timbers, current up to date, can in future be eliminated to a considerable extent by the erection of a modern plywood mill in the vicinity of the forest under exploitation.

The modern plywood mill, more correctly designated perhaps as a factory in its most up-to-date war-built design, may be regarded as considerably ahead of its predecessors, and has been the outcome of much thought and careful planning on the part of men who had made a thorough study of the problems to be met. Its erection involves a considerable initial outlay, which during war-time, it is said, has been fully justified due to two facts: the finished product is of the highest order and it is produced very expeditiously.

It is not the object of this article to describe the mill and the various stages through which the material produced by the rotatory cutter or peeler machine finally emerges in its plywood form. It is the possible enormous increase in out-turn per unit of forest to which attention is here directed. The logs—the larger the diameter the better within limits—arriving at the mill are cross-cut to the size required, not less than 7 ft., for the rotatory cutter, which is really a large-scale lathe. The barked log is placed between two spindles which are clamped into the centre of the ends and rotated against a fixed knife which runs the whole length of the log and thus takes a thin shaving off the whole circumference. The knife moves forward at a set speed, which is dependent upon the thickness of the shaving. It will be understood that until the log has been turned to a perfect cylinder only scrap material comes off, though even this is utilized. Once a perfect cylinder is achieved, the veneer comes off as a continuous (moist) sheet which is wound on to a drum. Veneers as thin as 1/90 in. can be cut in the most modern machines. The logs are turned down to an 8–9 in.-diameter core. The core may have defects, but in any event below this the small radius of curvature renders it brittle, the veneer thus splitting. The cores are now made use of for other purposes. In fact, in the modern mill, waste has been almost entirely got rid of. The roll of veneer after leaving the rotatory cutter passes through a number of processes before actually arriving at those in which its manufacture into the particular type of plywood being turned out is undertaken. Most of these processes are in the hands of women and are by no means uninteresting, while the condition in which the women work with artificial sunlight and the latest aerating devices are excellent.

The modern plywood factory is nothing short of a revolution in the prolongation of the life of, notably, the remaining primeval forests on the globe. Each log from each big-sized tree felled in these forests in the future can be put to its full use by man with the minimum of waste. The annual requirements in logs from any forest will thus be restricted automatically, and the existing amounts of timber still available be spread over a longer period.

Never perhaps in the history of the world has such a prolongation been more necessary, for never has a timber famine in one form or another loomed larger on the horizon. But man's cleverness in producing and perfecting the plywood mill will prove of little use unless the Governments of the chief countries concerned come together, and see that its apparent special advantages are made use of, and are not suppressed by existing vested interests, which have little in relation with the true economic uses and exploitation of the forest.

THE U.S.S.R. ACADEMY OF SCIENCES

JUBILEE SESSION

THE Soviet Academy of Sciences celebrated the twenty-fifth anniversary of the U.S.S.R. by a special jubilee session held at Moscow on November 15–18, 1942, and the papers read at the session have now been published in a very neat volume of 250 pages. Apart from the texts of the greetings messages sent by the Academy to Soviet leaders, to fighters of the Red Army and the Navy, to men of science of the world, etc., the volume contains a series of surveys of the progress achieved in the various spheres of the Academy's activities during the twenty-five year period.

Prof. A. A. Baikov reviewed general development of the Academy which in 1917 consisted of three sections (physico-mathematical; Russian language and literature; and historico-philological), with forty-five academicians and 212 other scientific and technical staff. By 1941 the Academy had eight sections (physico-mathematical; chemical; geologo-geographical; biological; technological; historico-philosophical; of economics and law; of literature and languages), with seventy-six institutes, eleven laboratories, forty-two stations, six observatories, twenty-four museums, in which were working 118 academicians, five honorary academicians, 182 corresponding members and 4,700 scientific and technical personnel.

Apart from these quantitative changes, the scope and the character of the work have also undergone great evolution, mainly in the direction of a closer contact between pure research and its applications. This tendency has found its practical expression in the elections to the Academy of a number of eminent engineers, industrial chemists, etc., and culminated in the organization in 1935 of a section of technology. In 1934 the Academy was transferred from Leningrad to Moscow and taken under the immediate control of the Soviet of People's Commissars which discusses and approves plans of research. In 1938 the Soviet recommended the Academy to concentrate its attention on the leading scientific problems necessary for the development of socialistic economics and culture. In 1939 the Academy elected J. V. Stalin as its member, and this event was regarded as a symbol of transformation of the Academy into the "general staff of Soviet science". Since the outbreak of war, the Academy has concentrated its attention on problems connected with the mobilization of natural resources for military purposes. Among such problems an outstanding place belongs to the work of a special commission for the mobilization of resources of the Ural, where great progress has been achieved in the scientific organization of metallurgical industry, and of Kazakhstan, where great reserves of coal, copper, nickel, etc., were discovered.

Prof. A. F. Joffe produced a summary of the development of exact sciences in the U.S.S.R. during the past twenty-five years. In 1918 the Institute of Physics and of Bio-physics (P. P. Lazarev), Physico-technical, Roentgen (A. F. Joffe) and Optical (D. S. Rozhdestvensky) Institutes were founded in Moscow. The Physico-Technical Institute supplied personnel for similar Institutes at Tomsk, Kharkov, Dnepropetrovsk and Sverdlovsk. The Physical Institute of the Academy (L. I. Mandelstam), which moved from Leningrad to Moscow, became a leading institution. New problems of application of physics in agriculture are studied by the Leningrad Institute of Agrophysics. Chemical science also has now a series of institutes: of general and inorganic chemistry (N. S. Kurnakov and L. A. Chugaev); of organic chemistry (A. E. Favorsky, N. D. Zelinsky); other institutes are devoted to colloids, electrochemistry, radiological chemistry, applied chemistry, chemistry of fertilizers, pharmaceutical chemistry, etc.

Astronomy advanced at a less rapid rate, but the Mathematical Institute of the Academy has developed into one of the world centres of mathematical science.

The progress of mining technology and of metallurgy, as reviewed by Prof. I. P. Bardin, reveals gigantic work of reconstruction in which academic institutions and scientific workers have taken an honourable part. An even more impressive picture is presented by Prof. A. V. Vinter in a survey of the energetics of the U.S.S.R.—a fascinating story of the utilization of the resources of the water and air, of the great hydro-electric installations, of the electrification of transport, etc.

In the biological sciences, as reviewed by Prof. L. A. Orbeli, the progress was mainly in the direction of planned research, concentrated on the leading problems of the Darwinian theory of evolution, which are studied not only in laboratories but also in the field. Spectacular progress can be registered, of course, in physiology as a heritage of the late Prof. I. P. Pavlov. Investigations of the floristic and faunistic natural resources of the Soviet Union are proceeding apace and many volumes of the "Fauna of U.S.S.R." and the "Flora of U.S.S.R." have been published.

The geological sciences (V. V. Obruchev) have made one of the greatest contributions to the economic development of the Union, and the Academy took an active part in the extensive and exhaustive investigations carried out by hundreds of expeditions in the remotest corners of the Union.

Not less than seven papers, occupying well over half of the volume, are devoted to the humanitarian sciences: the importance and place of the great October revolution in the history of mankind (E. M. Yaroslavsky); twenty-five years of the great October revolution and the patriotic war of the Soviet people (G. F. Alexandrov); Soviet State—a State of a new type (A. J. Vyshinsky); philosophical science in the U.S.S.R. during twenty-five years (M. B. Mitin); development of historical sciences in the U.S.S.R. during twenty-five years (B. D. Grekov); Soviet historiography (E. V. Tarle); a quarter century of Soviet literature (A. N. Tolstoi).

OBITUARIES

Sir William Noble

SIR WILLIAM NOBLE, who died on November 10 at the age of eighty-two, had devoted the whole of his active and strenuous life to the service of electrical communication, in which he rose from the humble grade of telegraph messenger to the leading position in the British Empire. He was appointed as a Post Office telegraphist at Aberdeen in 1877 at the age of sixteen, and at once began to show a keen interest in the electrical and technical sides of the telegraph service. He gained many medals, prizes and other honours and after a few years became a lecturer in electricity and telegraphy at Gordon's College, Aberdeen. It was not, however, until 1893 that he obtained a transfer to the P.O. Engineering Department as sectional engineer at Aberdeen. He soon attracted the notice of his departmental chiefs and thereafter his advancement was rapid. In 1897 he was personally selected for appointment as first-class engineer on the headquarters staff in London, by Sir John Gavey, who had had occasion to observe a highly original and efficient means he had devised for the mechanical testing of telegraph poles. Further promotions carried him through the grades of technical officer, assistant superintending engineer, and staff engineer, to that of superintending engineer for the London District in 1907. In 1912 he became assistant engineer-in-chief and in 1919 he succeeded Sir William Slingo as engineer-in-chief, a position which he held until his retirement from the Government service in June 1922.

Sir William Noble, who received a knighthood in 1920, was intimately concerned with all the many scientific, technical and commercial developments of the Post Office communications services during his long period of responsible office. As an administrator he had a genius for selecting the right man for the right place; he made quite exceptional efforts to make and maintain personal acquaintance with all the leading personalities of his great staff throughout the country. Every good and enterprising officer could count upon his understanding assistance and support, and he was accepted as guide, philosopher and friend by all.

Shortly after his transfer to headquarters in 1897 he plunged into the heavy work of the initial 'telephoning' of London on the basis of underground multiple cables in all central areas and the 'central battery exchange' system throughout. This involved pioneer work of much diversity and the careful gathering and maturing of experience in readiness for the complete transfer of the National Telephone Company's local exchange system to the Post Office in 1911. (The National Trunk Line system had been transferred to the Post Office in 1895.) The full transfer in 1911, and its aftermath, also brought him much strenuous work, not the least of which was the unification and fitting in of the large technical staff of the National Telephone Company with that of the Post Office; in this delicate work he played by far the most important part, and its smooth and successful accomplishment stands to his credit. He had the subsequent development of the new situation well in hand when unfortunately the outbreak of the War of 1914–18 put a stop to everything. The changed financial situation and the industrial difficulties and confusion of the early post-war years introduced further obstacles, and meanwhile public criticism of the shortcomings of the country's telephone service became acute. Sir William's manful efforts to put the past and the future in proper perspective, both in the public Press and before parliamentary committees, will still be within the recollection of many.

When, a little later, Parliament set up the Geddes Committee with instructions to wield the economy 'axe' among Government departments, Sir William's able demonstration of the economic side of the Post Office Engineering Department, and its methods of continuously assessing and fostering the efficiency of capital and maintenance expenditure in all districts, carried conviction, with the result that his Department was one of the very few Government departments to receive a complimentary testimonial from the Geddes Committee.

Sir William was deeply interested in, and did much to encourage, the adoption of long-distance trunk telephone cables in place of overhead wires on pole lines. Even before the advent of the telephone repeater, communication from London to Birmingham, Leeds, Manchester and Liverpool had been provided by means of multiple twin cables carrying comparatively heavy copper conductors. On the invention of the thermionic valve, with its almost limitless applications to the amplification of high-frequency electrical oscillations, he recognized at once that the situation had been transformed by the introduction of a new factor which would place the means of achieving world-wide telephony in the hands of his successors.

His interest in radio communication was continuous from the early days in which he assisted Sir William Preece in experiments in inductive (or perhaps one should say earth conductive!) wireless telegraphy between parallel wires along the opposite sides of Loch Ness, up to the times when he was chairman of the first Broadcasting Committee and afterwards one of the founders of the British Broadcasting Company, of which he was a director from 1922 until 1926.

The development of the automatic switching systems of telephony was another subject very near his heart, and one in which he retained an active interest after his retirement from the Post Office in 1922 when he became a director of the General Electric Company. From that date until quite a short time before his death he was managing director of that Company's telephone manufacturing works at Coventry, a source from which has emanated much of the automatic switching plant, telephone repeater equipment and many other items of communications engineering used by the Post Office and other administrations.

Sir William's commercial and social activities were many and varied. He made many friends and few if any, enemies. On his professional side he may be summed up as a man of abounding energy, vision and executive power.

Sir William was always proud of his Aberdeen origin and the feeling was mutual; "a citizen of no *mean* City", he used to say. T. F. PURVES.

Dr. Alexander Lauder

ALEXANDER LAUDER died at Greenock, his birthplace, on November 11, at the age of seventy-three. He studied first under Prof. Dittmar, in what is now the Royal Glasgow Technical College, and then with Prof. Crum Brown at Edinburgh before taking up his first appointment as assistant to Prof. (later Sir J. J.) Dobbie in the newly founded University College of North Wales at Bangor.

In addition to assisting in the Chemistry Department, he took up the study of agricultural chemistry and carried out experimental work, more particularly n connexion with the field experiments. In conunction with Prof. Dobbie, he made an elaborate nvestigation into the alkaloids of *Corydalis cava* and worked out the constitution of these alkaloids, the results being published in a series of papers in the *Journal of the Chemical Society* (1892–1904). Along with Prof. Dobbie, he took up the study of absorption spectra and investigated the connexion between the chemical constitution and the absorption spectra of certain organic compounds, in which work they were pioneers.

In 1904 Dr. Lauder was appointed head of the Chemistry Department of the newly founded Agricultural College, Edinburgh, and in 1907 also became esponsible for the teaching of agricultural and forest chemistry to the University degree classes. In addition to his teaching, he carried out many investigations in various branches, giving particular ttention to the composition of milk as affected by the feeding of the animal, the composition of swede turnips and heather and differences of a chemical nature in potato varieties. Most of that work was published in the *Scottish Journal of Agriculture* and in *Agricultural Progress* or in special reports. He retired in 1936.

Dr. Lauder had also a long record in administration, for he acted at various times as secretary and treasurer to the College and as director of studies for four or five years immediately after the War of 1914–18. He served on the councils of the Royal Institute of Chemistry and the Society of Chemical Industry, and was chairman of the East of Scotland Branches of the Chemical Society and the Royal Institute of Chemistry. He was prominently identified with the work of the Royal Society of Edinburgh and served on the council for ten years and was assistant secretary to the ordinary meetings for five years. He also took an active share in the work of the British Association, being for a time secretary of the Agricultural Section, and president of the Section for the Leicester meeting in 1933 when the subject of his address was "Chemistry and Agriculture".

Dr. Lauder was much interested in music and in English literature. He was a member of the Reid Orchestral Committee for many years, an active member of the Bach Society, and various other musical bodies. He had accumulated a library of standard English works, the study of which gave him much pleasure.

By those who knew him, he will always be remembered for the services he gave so ungrudgingly, for his sound judgment, for his wit and generous nature.

WE regret to announce the following deaths:

Prof. J. Macfarlane, emeritus professor of botany in the University of Pennsylvania, on September 16, aged eighty-seven.

Prof. Umetaro Suzuki, president of the Scientific Research Institute, Manchukuo, emeritus professor in the Imperial University of Tokyo, aged sixty-nine.

NEWS and VIEWS

Presidential Address to the Royal Society

IN the course of the presidential address to the Royal Society, delivered as customary on St. Andrew's Day, Sir Henry Dale noted that Sir Henry Tizard, foreign secretary of the Society, has returned from a scientific mission to Australia, and that Prof. A. V. Hill, the senior secretary of the Society, has gone to India as a result of a request sent to the Society by the Government of India. Prof. Hill is to consult with that Government on scientific affairs, and in particular is to advise on scientific and industrial research in relation to measures of post-war reconstruction, and on the co-ordination of such plans in India with corresponding activities elsewhere. During his absence, Prof. E. J. Salisbury will take Prof. Hill's place as biological secretary of the Society. During his visit to India, Prof. Hill hopes to carry out a unique ceremony. It is part of the formal admission of fellows of the Society that they subscribe the obligation in the Charter Book; of the six Indian fellows, only two have hitherto been able to do this. Prof. Hill has accordingly been provided with a sheet of suitable parchment on which the fellows' obligation is inscribed, and the four Indian fellows who have not yet signed the Charter Book will be formally admitted to the Society.

Sir Henry Dale then passed on to discuss the needs of research. He claimed for science its share of credit for the change of prospects now apparent in the War; and remarked that while science cannot afford to relax its efforts, it must also look to the future. If Great Britain is to hold its place alongside new civilizations built from their foundations on modern science, such as those of the U.S.S.R. and China, we must think of research on a higher as well as larger order than hitherto. The Royal Society will welcome any movement advocating great expansion of the nation's support of applied research, whether through the Government's Research Councils, through Departments concerned with the uses of science for defensive preparations in peace-time or for other national interests, or with the training of recruits for research by the universities. Fundamental researches also must not be neglected. British discoverers are as great as any in a world era of great discovery, but often they have lacked proper equipment and accommodation. They must not be so handicapped in the more pressing times to come. The Council of the Royal Society has appointed a committee to consider the needs for fundamental researches in physics; no doubt other departments of science will have similar needs. The primary duty of the Royal Society is to aid researches which seek the advancement of knowledge without immediate reference to its use, though it appreciates clearly that such progress is often necessary to practical advances. Finally, Sir Henry referred to the need of the Royal Society for a home more worthy of its importance; he spoke of investigations which have been made, with the help of the assistant secretary, Mr. Griffith Davies, of the different homes the Society has occupied. Elsewhere in this issue (p. 649) we print Sir Henry's remarks on this topic.

Scientific Work in India

In the August number of *Discovery*, Sir Lewis Fermor gives an interesting account of the history and development of pure and applied science in India. It is well known that India possesses a very ancient culture and civilization. As regards ancient science, the Hindus made important contributions to mathematics, and, as Sir Lewis points out, they possessed a considerable knowledge of zoology, medicine and chemistry. Sir Prafulla Chandra Ray's book on the "History of Hindu Chemistry" from the earliest times up to the middle of the sixteenth century A.D. provides valuable information concerning this branch of science. The conquests of Alexander the Great gave India an important stimulus to intercourse with Europe, but, as Sir Lewis observes, much ancient Indian science antedates this Greek influence. Moreover, it must not be forgotten that when the Arabs brought science to Europe, their knowledge derived from Indian as well as Greek sources. Although in its earlier days the East India Company did not employ scientific men as such in India, it is a striking fact that James Prinsep, one of the Company's official assayers, deciphered in 1838 the ancient Brahmi script used in the rock-cut inscriptions or edicts of the Indian Buddhist king, Asoka (died *circa* 237 B.C.).

According to Sir Lewis Fermor, the modern development and study of science in India began with the coming in 1783 of the Puisne Judge of the Supreme Court, Sir William Jones, who in 1784 founded the "Asiatick Society", later to become the Royal Asiatic Society of Bengal. A portrait of Sir William Jones accompanies the article. Concerning the very great development of Government services depending on applied science, universities and colleges, scientific societies, scientific journals, and academies of science, which has taken place in India during the nineteenth and especially the twentieth century, readers will find here an excellent account. The universities, colleges, and academies of modern India, including the Indian Institute of Science at Bangalore, founded by the eminent Parsee family of Tata, make important contributions to the advance of pure and applied science. A number of these discoveries are referred to by Sir Lewis, who adorns his article with the photographs of eight eminent Indian men of science, namely, Dr. H. J. Bhabha, Sir Shanti Swarupa Bhatnagar, Dr. K. S. Krishnan, Sir C. Venkata Raman, Prof. M. N. Saha, Prof. B. Sahni, the late Sir J. Chandra Bose (all fellows of the Royal Society), and Sir P. Chandra Ray.

Insulin Colour Code

Noteworthy steps in the direction of co-operation in production and distribution have been made by the four firms (Allen and Hanburys Ltd., Boots Pure Drug Co. Ltd., British Drug Houses Ltd., and Burroughs Wellcome and Co.) entrusted with the manufacture of insulin in Great Britain. These firms mindful of their special responsibilities to the diabetic community, have throughout the War period pooled their research, manufacturing and distributive facilities to ensure an adequate and uninterrupted supply of their products to those in daily need of them and to reduce their prices, in the face of rising material and labour costs, to the lowest practicable level Three distinct types of insulin—Unmodified Insulin Protamine Zinc Insulin and Globin Insulin (with Zinc)—are in regular use in Great Britain. Alternative strengths of two of these make a total of six different preparations, and confusion between them might easily be attended by serious consequences To reduce this possibility to a minimum, the British insulin manufacturers have agreed to adopt a uniform design for labels and cartons, by which each type and strength of insulin, of whatever make, wil be readily identifiable by a distinctive colour scheme In addition, the unit strength per c.c. will be displayed in bold figures on both label and carton. An explanatory card, printed in colours, is obtainable from any of the manufacturers on request. The change which will take place on January 1, was made afte consultation with leading authorities and with the approval of the Ministry of Health.

Animal Population of a Seaport

An exhibit entitled "The Population of a Seaport was recently installed in the Zoology Department o the National Museum of Wales. It is based on the fac that any great city to-day is a habitat characterize by a particular community of animal species; i this case including, and largely dependent on, man Examples of this urban fauna—certain birds, domestic animals, rodent and insect pests, etc.—are shown and the interrelationships of the species, betwee themselves and with man, illustrated by coloure tapes running from one animal to another and thenc to a small bust representing man. As man create the habitat for this community, he can control i for the better, notably by improved town-planning whereby, for example, desirable bird-life may be increased, and improved house-building, whereby rats cockroaches, etc., may be diminished. As indicate in the labels, these and some other urban pests wer originally introduced by shipping, and specimens ar displayed of the numerous alien species that thu reach our seaports; those which have establishe themselves, however, have mostly spread inland and are to-day familiar in all large towns. As abou 80 per cent of the population of Britain are urba dwellers, such an exhibit should assist the majorit of visitors to envisage this biological background t their environment, and the advantages to be achieve by its improvement and control. An article describing the exhibit appears in the October number of th *Journal of the Royal Institute of British Architects.*

Recording Cathode Ray Oscillograph Traces

The technique of recording cathode ray oscillograph traces was the subject chosen for the Novembe meeting of the Association for Scientific Photography the speakers being Mr. W. Nethercot (E.R.A.) and

Mr. N. Hendry (Rotax, Ltd.). Mr. Nethercot's paper dealt with the recording of high-speed transient phenomena by hot-cathode glass-bulb tubes, and examples were shown of wave-forms of 20 Mc./sec. and above. In single transient recording the beam raverses the screen only once, and the exposure ime of the film is therefore determined by the duration of the glow from the screen, since the actual traverse time may be only a fraction of a microsecond. Photography by direct contact of he film with the screen has so many disadvantages that it is only suitable for transients of simple wave-shape where blurring of the trace and curvature of the screen do not affect the result appreciably. The most satisfactory method is by means f a specially designed camera.

Since the majority of the light emitted from a blue-screen tube (the optimum material for recording) is in the blue-violet region, it is not necessary to use an achromatic lens; further, the corrections necessary or a high-grade camera lens are not required for scillographic recording at a fixed distance. The best results are obtained with ortho emulsions; with panchromatic films the glow of the tube cathode frequently caused fogging on the centre of the record. Mr. N. Hendry, in dealing with the requirements of both cameras and tubes for recording, pointed out that small changes in the setting of the brilliancy control make large differences in the apparent recording sensitivity due to change in spectral emissivity of the screen with beam current. For many purposes, particularly where the reproduction of records is not required and the highest speed is not necessary, recording paper is as satisfactory as film, and more economical. The usual mercuric iodide intensifier gives good results, as does also a silver intensifier. In the discussion which followed, Dr. H. Moss (A. C. Cossor) spoke of the correction necessary for screen curvature of the tube, and Mr. G. Parr (*Electronic Engineering*) showed four simultaneous traces on recording paper taken from two gas-focused tubes with electronic switching of the beam.

The Clinical Society of London, 1868–1907

In his recent presidential address on this subject before the Clinical Section of the Royal Society of Medicine, Dr. J. D. Rolleston said that the formation in 1868 of the Clinical Society of London, the parent of the Clinical Section of the Royal Society of Medicine, was mainly due to Dr. Headlam Greenhow and Dr. (afterwards Sir John) Burdon Sanderson, who were both assistant physicians of Middlesex Hospital, the latter being afterwards appointed Waynflete professor of physiology and eventually regius professor of medicine at Oxford. According to Dr. Rolleston, the most interesting historical event connected with the linical Society was the first medical description in reat Britain of X-rays, which was made before it nearly fifty years ago. Early in 1896, the Society invited Prof. Silvanus Thompson to tell its members about the new discovery; a special meeting was held on March 30, 1896, and was attended by nearly four hundred members. Later, numerous cases illustrating the diagnostic and therapeutic value of X-rays were reported at meetings of the Society and recorded in its *Transactions*. A remarkable custom in the practice of the Society was the frequent establishment of special committees to discuss various bjects or individual cases. The most important of these committees were those on myxœdema, the periods of incubation and contagiousness of certain infectious diseases and the antitoxin of diphtheria. The course of the Society was successful from the first. At the time of its amalgamation in 1907 with sixteen other societies it numbered 572 ordinary members and 17 honorary members. The first meeting was held on January 10, 1868, under the presidency of Sir Thomas Wilson, who was regarded at the time as the greatest English physician of the century and was author of a text-book on medicine which was without a rival for more than thirty years.

Early Science in the United States

Two recent issues of the *Proceedings of the American Philosophical Society* (No. 1, vol. 86, 1942, and No. 3, vol. 87, 1943) contain some interesting historical material and illustrations. The first, bearing the title "The Early History of Science and Learning in America with Especial Reference to the Work of the American Philosophical Society during the Eighteenth and Nineteenth Centuries", contains papers read before the Society at its mid-winter meeting in February 1942, and is inspired by the fact that that year saw the close of two hundred years of activity by the Society, which was organized by Franklin in 1743. It certainly seems a good plan to prepare for such a celebration as a bicentenary by the preliminary presentation of papers of this kind, in which various contributors deal with the Society's early activities in a wide range of fields, including, among others, agriculture, meteorology, climatology, engineering, vertebrate palæontology, and so on; there is also an interesting biographical study of James Logan (1674–1751) and a carefully documented account of a memoir by Rafinesque that has been generally overlooked.

The other issue, entitled "Thomas Jefferson", contains papers read before the Society in celebration of the bicentenary of its third president, that great American, Thomas Jefferson, in April of 1943, at the actual bicentenary of the foundation of the Society, which was also the bicentenary of Jefferson's birth. Various contributors ably discuss Jefferson's life and times, his political philosophy, and his many scientific interests and pursuits. Dr. Harlow Shapley's paper on Jefferson as a natural philosopher was printed in Nature of August 14, p. 178. The figures of Franklin, Jefferson and Rittenhouse stand out once more in these pages, and fitly in these days we are reminded of Jefferson's oath of "eternal hostility against every form of tyranny over the mind of man". It is perhaps strange that in two places there recurs the old claim that Hadley's quadrant, "with the aid of which the European nations traverse the globe", was invented by the American, Godfrey, although this matter has been cleared up long ago.

The High-Frequency Marine Radio Unit

An original conception of the Federal Telephone and Radio Corporation, now being adopted by ship architects in the United States, is the marine high-frequency unit—an entirely self-contained, complete, high-frequency ship installation, including transmitter, receiver and power equipment in a single housing with projecting shelf for operating purposes. In addition to providing a simple, flexible and effective way of supplying long-distance communication facilities over a continuously variable frequency range of 2–24 m.c. to any ship, it possesses advantages as regards installation, training, operating and servicing comparable with the marine radio unit. The development of these two units enables ship designers and marine architects to determine well in advance the exact space requirements needed for a complete modern radio room installation for both medium and high frequency. Waste of valuable capacity in the ships' structures can thus be avoided, and, in fact, the new units are already influencing the design of ships' radio rooms. An article by E. J. Girard (*Elec. Comm.*, 21, No. 2; 1943) describes the new high-frequency unit, its circuit features, power supplies and installation. The new equipment employs the unit construction principle for shipboard radio installations. High-frequency radio transmitting and receiving equipment supplements standard frequency installations to provide, through choice of proper frequencies, means of direct communication with points far beyond the range of standard-frequency working. Since long-distance communication on high frequencies is accomplished with relatively low power, economy of operation is maintained even though the range is vastly extended. With elimination of ship-to-ship relaying of messages, accuracy and reliability are improved and communication with home ports is accelerated.

Eclipse of the Sun, Sept. 21, 1941, in the U.S.S.R.

A SPECIAL publication of the Academy of Sciences of the U.S.S.R., which has somewhat belatedly reached Great Britain, deals with the eclipse of September 21, 1941, and contains four papers written before the eclipse. The first, by A. Michailov, gives a detailed calculation of the circumstances of the eclipse in southern Siberia, and includes two charts from which the times of beginning and ending of the partial eclipse and its magnitude can be obtained for any point in the U.S.S.R. The second paper, by the same author, gives computations of the corpuscular eclipse, using four different velocities of particles, namely, 5000, 3000, 1600 and 800 km./sec., and assuming various sizes for the emitting surface of the sun, from a point to the full disk. A chart shows also the lines of totality for the optical ionospheric eclipse, at heights of 100, 150, 220, 300 and 500 km. A paper by B. Fessenkoff contains the plan of campaign as worked out by the Eclipse Commission of the Academy of Sciences, gives a general summing-up of recent experience in eclipse expeditions, and describes fairly fully the technique to be used in the astrophysical observations, which are concerned largely with the corona. Finally, P. Tverskoy discusses the geophysical problems to be investigated: mainly the radio exploration of high atmospheric levels in order to determine the relative importance of corpuscular and ultra-violet radiation there; secondly, the investigation of the effect on the solar radiation of the various parts of the atmosphere, including its lower layers; and lastly, an attack on the inverse problem, namely, how the eclipse affects physical conditions in the lower atmosphere. No detailed results have yet reached Great Britain, but a preliminary note (*J. Phys. U.S.S.R.*, 6, 1; 1942) gives ground for hope that much of the work planned was in fact carried out successfully.

Typhus in Palestine

ACCORDING to the *Lancet* of October 16, there have been 23 deaths from an outbreak of typhus during the past eight months in Palestine. The southern districts were chiefly affected, and the Department of Health has prepared special delousing units and portable showers for use in future cases. The disease is thought to have been introduced from neighbouring countries, especially Egypt. Murine typhus conveyed by rats is endemic in Palestine, but the present epidemic, which is more serious, is lice-borne and has not been seen in Palestine since the end of the War of 1914–18. A vaccine has been used with good effect, and a special laboratory for research and control of typhus has been opened under the charge of Prof. Kligler, head of the Department of Bacteriology and Hygiene (see also NATURE of November 27 p. 627).

South African Bored Stones

PART 4 of "The Bored Stones of Southern Africa by A. J. H. Goodwin (Univ. of Cape Town: Comm from the School of African Studies, Pt. 4. 2*s*.) ha recently reached Great Britain. It deals wit (*a*) the bored stones from the Cape of Good Hop and (*b*) certain elongated types. Together with th previous papers dealing with these special types o stone objects, this further statistical work will b very useful to the student of the Stone Age in Sout Africa.

University of Edinburgh

THE University of Edinburgh has received intima tion of a bequest by Dr. William Llewellyn Pryc Bevan, of Alton, Hants, of approximately £22,00 for the promotion of the teaching or the advance ment of medical science.

The Polish School of Medicine at the Universit of Edinburgh has added to its teaching staff Pro Maria Gutowska (medicine) and Dr. A. Jablonsk (natural philosophy).

Announcements

THE Committee of Privy Council for Medic Research has allowed amendments to the charter the Medical Research Council, simplifying the rul governing the retirement of members of the latt body and increasing the number of members by on By further Orders of the Committee of Privy Counci made after consultation with the president of th Royal Society and with the Medical Research Counci Prof. L. J. Witts, Nuffield professor of clinic medicine in the University of Oxford, and Prof. J. Learmonth, surgeon to H.M. Medical Household i Scotland, professor of surgery in the University Edinburgh, and surgeon-in-ordinary, Edinburg Royal Infirmary, have been appointed to be membe of the Medical Research Council.

THE Finney-Howell Research Foundation, Inc announces that all applications for fellowships f next year must be filed in the office of the Foundatio 1211 Cathedral Street, Baltimore, Maryland, January 1, 1944. This Foundation was provided f in the will of the late Dr. George Walker of Baltimo for the support of "research work into the cause causes and the treatment of cancer". Fellowshi carrying an annual stipend of 2,000 dollars ar awarded for the period of one year, with the poss bility of renewal up to three years.

DR. F. W. EDRIDGE-GREEN has pointed out th it is incorrect to attribute to Theodor Engelman the discovery of the cones and pigment cells of th retina (NATURE, Nov. 13, p. 560). Engelmann's mo important work was the discovery of the movemen of Deiter's cells and the pigment cells of the retir under the influence of light. Kölliker described th rods and cones of the retina in 1854.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Vitamin P-Deficiency in Guinea Pigs

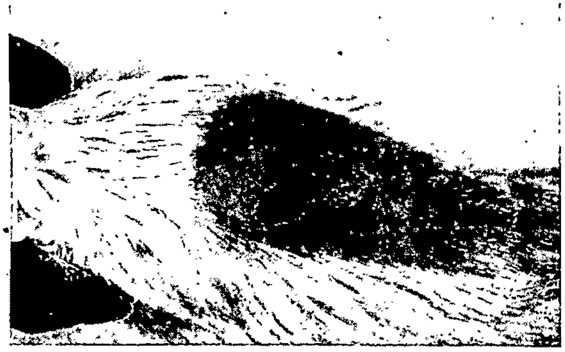
THE existence of vitamin P was first postulated by Szent-Györgyi and his colleagues[1,2] in 1935 and 1936. Other workers have since failed to substantiate their original conclusions[3,4]. However, so far as guinea pigs are concerned, Zacho[5] and Bacharach[6] have obtained considerable evidence that vitamin P deficiency is a reality. The fall in capillary resistance obtained by Bacharach and his co-workers[6,7] is small, but they have been able to show a statistically significant difference between the capillary fragility of the normal and the P-deficient guinea pig.

By taking a different end-point from that used by Bacharach in estimating capillary fragility in guinea pigs, I have obtained striking falls in capillary resistance and correspondingly large rises upon administration of citrin.

The technique used was fundamentally the same as that used by Bacharach[6], with the following differences. The suction cup was 20 mm. in diameter. It was placed on the shaven Vaselined skin of the animal and the pressure rapidly reduced to the desired level. It was left at this level for ten seconds and then released. The cup was removed and the skin examined for petechiæ. The capillary resistance was taken to be the negative pressure at which so many petechiæ developed that the area where the suction was applied became uniformly reddish-purple in colour; in other words, a hæmatoma was produced. Various sections of skin were tested until a positive result was obtained.

A total of 54 guinea pigs has been placed on the scorbutogenic diet used by Bourne[8] and each animal given 10 mgm. per day of vitamin C by mouth (Bacharach gave 5 mgm.). Their capillary resistances were taken on the day they were placed on the scorbutic diet, and in most cases at weekly intervals afterwards. In 30 normal animals no hæmatoma could be produced at 560 mm. mercury or more negative pressure. In the remaining 24 animals a hæmatoma was produced at negative pressures varying between 460 and 560 mm. of mercury.

The capillary resistance of individual animals took varying times to fall. The longest time for it to fall was eight weeks and the shortest time three weeks. The capillary resistance fell in all cases by at least 50 per cent and in some cases by more.



HÆMATOMA PRODUCED BY A NEGATIVE PRESSURE OF 310 MM. OF MERCURY IN A *P*-DEFICIENT GUINEA PIG. FIVE WEEKS PREVIOUSLY A NEGATIVE PRESSURE OF 560 MM. MERCURY HAD FAILED TO PRODUCE ANY EFFECT IN THIS ANIMAL.

Fifteen of these animals after the fall of capillary resistance had occurred were given five doses of 10 mgm. of citrin over a period of six days, and the capillary resistance was taken again on the seventh day after the test dosing began. Rises of from 60 per cent to more than 100 per cent took place in the capillary resistance. In those animals in which citrin was not given, the capillary resistance remained at a low level. After a few weeks, however, there was a slight rise in some of the animals, but it did not in any case amount to more than 20 per cent.

The actual figures obtained from these fifteen animals are shown below:

Normals (mm. negative pressure)	After some weeks on P-deficient diet (mm. negative pressure)	After treatment with 10 mgm. citrin (5 daily doses) (mm. negative pressure)
610	410	>560
>610	260	410
>610	310	460
>610	310	410
>610	360	>560
>660	410	>560
560	310	>560
>560	360	510
610	310	>560
>610	310	460
>560	310	410
>610	360	>560
>610	410	>560
560	310	>560
460	210	360

Such figures scarcely need statistical analysis, but as a matter of interest this has been done. It is difficult to compare figures such as >560 and >660 with other data, but by multiplying the reciprocal of each pressure by 1,000 a series of index figures has been obtained which it has been possible to subject to statistical examination. Figures bearing the prefix > are all given the index figure of '0'.

The application of this process to a few sample figures is shown below.

mm. pressure (P)	$1{,}000 \times 1/P$
>560	0
560	1·79
460	2·17
360	2·78
310	3·23

The average index figure for the 54 normal animals is 0·8050 ± 0·1250; that for the 54 P-deficient is 3·1810 ± 0·0880; that for the 15 P-deficient and citrin-treated animals is 1·0930 ± 0·3200.

If we compare these means by Fisher's '*t*' test, we find that the differences between those for the normal and the P-deficient animals and for the P-deficient and citrin-treated animals are highly significant. The means for the citrin-treated and the normal animals do not, however, differ significantly from each other.

The capillary resistance of a guinea pig on a scorbutic diet but receiving 10 mgm. per day of vitamin C will thus fall to a statistically lower level over a period of 3–8 weeks, and 5 daily doses of 10 mgm. citrin will bring the capillary resistance back to a level at which it is not statistically different from the normal. When the citrin treatment is discontinued, the animals sometimes die from a form of broncho-pneumonia, but in those which survive, the capillary resistance falls to its previous level over a period of 1–4 weeks.

It is difficult to resist the conclusion, in the face of these results coupled with those of Bacharach and Zacho, that vitamin P deficiency can exist, at least so far as guinea pigs are concerned, and that citrin contains a substance or substances (vitamin P), the effect of which is to return the capillary resistance to normal.

The pressures given were recorded on a spring manometer corrected against a mercury manometer.

I am indebted to Messrs. Roche Products for the supply of citrin and vitamin C used in these experiments.

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University Laboratory of Physiology,
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Nov. 9.

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Human Poliomyelitis in the Developing Chick Embryo

Several attempts by different authors[1] to propagate human poliomyelitis virus in the developing chick embryo have been entirely negative. In these experiments the technique employed was that elaborated by Burnet, the eggs being inoculated on the 10–12th day of incubation. Recently, however, I reported[2] successful transfer to, and serial passage in, chick embryos of mouse poliomyelitis virus (Theiler's virus). In conformity with the observation by Kligler and Bernkopf[3] on rabies virus, it was found that only young embryos—5–7 days old—were susceptible to infection. The virus was restricted to the central nervous system, and no lesions were detectable.

Although the conditions were most unfavourable for the continuation and extension of these experiments, in that the hatching eggs obtainable were of low quality, the mortality rate of the embryos being very high, and the supply of monkeys was depleted and could not be restored, it was considered worth while to try the same technique on human poliomyelitis virus. The result of the first attempt was promising, although not entirely convincing. As the experiments had to be discontinued for the time being, the present observation will, however, be reported.

The strain of virus used was the *L* strain, adapted to monkeys and of a uniformly high virulence. A 10 per cent suspension of glycerolated monkey cord was inoculated in 0·05 ml. amounts in four eggs on the sixth day of incubation. One embryo died on the day after inoculation; the remaining ones were all alive and showed normal development at the termination of the experiment. On the 10th day after inoculation the eggs were opened and the brains of the embryos harvested. 0·5 ml. of a pooled 10 per cent brain suspension was inoculated intracerebrally in a Rhesus monkey, an old animal with traces of a previous cage paralysis. Rectal temperature readings were taken daily for four weeks. With the exception of a slight fever during the first five days after inoculation, nothing abnormal was observed. The temperature of this animal was rather low, not exceeding 37·7° C. The result was considered negative. On the 70th day after inoculation, however, the animal displayed certain disturbances, irritability and slight tremor, and its fur was ruffled. On the following day the temperature was 38·4° C. and rose to 39·9° the day after. On the 73rd day the temperature fell to 36·4° in the evening and was 35·8° on the morning of the 74th day. Paresis of the legs became evident on the 71st day. On the 74th day a quadriplegia had developed. The animal was sacrificed. No gross lesions were observed at autopsy. Microscopic examination revealed typical lesions in the pons region, medulla oblongata, and all levels of the spinal cord, consisting of perivascular cuffing, scattered infiltration in the grey matter, and neuronophagia.

No other diagnosis than poliomyelitis presents itself. With the exception of this experiment, no work on human poliomyelitis had been carried out in the laboratory for more than six months previously. Accidental infection of the animal must, therefore, be considered most unlikely. In these circumstances the experiment gives suggestive evidence that human poliomyelitis virus can be propagated in the central nervous system of young chick embryos. The unusually long incubation period in back passage to monkey indicates that the concentration of virus remains on a low level.

This work was sponsored by the Konung Gustaf V's 80-Årsfond.

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Institute of Physical Chemistry and
Department of Hygiene and Bacteriology,
University of Uppsala.
Sept. 25.

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[1] Burnet, F. M., *Med. J. Austral.*, **1**, 46 (1935). Gavrilov, W., and Fester, A., *Arch. ges. Virusforsch.*, **1**, 404 (1940).

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Products Formed in Pyrethrin Concentrates during Storage

In the course of work on the structure of the pyrethrins, concentrates rich in pyrethrins I and II were stored in the dark for some months. It was then found that the concentrates were no longer completely soluble in petroleum ether and, surprisingly, that the insoluble residues showed a high 'apparent' pyrethrin content when assayed both by the Wilcoxon-Holaday and Seil methods[1], in spite of their low toxicity to house flies in comparison with freshly prepared pyrethrum extracts at equivalent concentrations. Thus two typical residues showed (Sample *A*) pyrethrin I, 13·5 per cent w/w, pyrethrin II, 64·7 per cent w/w (Wilcoxon-Holaday), and pyrethrin I, 15·1 per cent, pyrethrin II, 65·1 per cent (Seil), and (Sample *B*) pyrethrin I, 43·1 per cent, pyrethrin II, 7·5 per cent (Wilcoxon-Holaday), and pyrethrin I, 47·5 per cent, pyrethrin II, 7·2 per cent (Seil), yet 1 per cent solutions of these residues in acetone were less effective against house flies under exactly comparable conditions than a 0·1 per cent solution of pyrethrins in the same solvent made up from concentrates of the same type but freshly prepared. In addition, appreciable absorption of light was observable (in alcoholic solution) at the absorption maximum characteristic of the pyrethrins²; thus (*A*) showed $\lambda_{\text{max.}}$ 2310 A., $E^{1\%}_{1\text{cm.}}$ 144, whereas (*B*) showed $\lambda_{\text{max.}}$ 2280 A., $E^{1\%}_{1\text{cm.}}$ 495.

It has been shown³ that the light absorption of the pyrethrins is almost certainly due to a summation of the separate contributions of two isolated chromophores (*a*) a conjugated dienoid system in the pentadienyl side chain, and (*b*) an αβ-unsaturated ketonic grouping in the *cyclo*pentenolone ring. In view of hese data and the fact that the chemical methods of assay mentioned above depend, respectively, upon he properties of the carbonyl group and of the chrysanthemum mono- and di-carboxylic acids, it eems most reasonable to assume that the αβ-unsaturated ketonic grouping and the acidic fragments of the pyrethrin molecules remain unaltered in these esinous products but that the change—probably polymerization—involves the pentadienyl side chain. The accompanying great reduction in toxicity of such products, with retention of some degree of biological activity, would appear to be in accord with the conclusions of Staudinger and Ruzicka⁴ on the effect on toxicity of changes in the molecular structure of pyrethrins I and II and related synthetic compounds. Furthermore, it has been observed¹ that saturation of the side chain in the pyrethrin II molecule leads to a great decrease in both 'knock-down' and lethal effects.

T. F. WEST.

Stafford Allen and Sons Ltd.,
London, N.1.
Oct. 28.

Green, R. G., Pohl, W., Tresadern, F. H., and West, T. F., *J. Soc. Chem. Ind.*, **61**, 173 (1942).

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Relation of Tea 'Fermentation' to Normal Respiration

IT is correct, as Roberts states in his communication¹, that I did not "repeat the conditions under which the Tocklai experiments were carried out". I attempted² to simulate injuries to tea leaf comparable with those caused during normal tea manufacture. Roberts, however, used an attachment which will grind nuts to a fine paste and thereby caused more structural damage to the leaf than I did with a mincing machine and far more than ever results from tea-rolling during manufacture. He attaches great importance to the shearing forces produced by his attachment because he believes that "such shearing forces are to be considered as responsible for the disorganization of respiratory processes which results in tea-fermentation"—even in the absence of visible cell damage. His own published results³, however, do not give support to that belief.

Roberts shows that two non-tanniferous tissues, *Tropæolum majus* and *Hibiscus rosasinensis*, have a carbon·dioxide output of 1·98 μl. and 1·6 μl. respectively per mgm. dry weight of tissue per hour, which when compared with the value 1·29 μl. found by Boysen Jenson⁴ in respiration experiments on *Tropæolum majus* shows them to be of the same order. There is no question of polyphenol oxidation in these tissues, and since the *R.Q.* is very near unity the carbon dioxide output is presumably all due to normal respiration.

As Roberts's experiment demonstrates that very severe mincing plus the shearing effects produced by the attachment do not completely disorganize the respiratory process in *T. majus* and *H. rosasinensis*, why must we *assume* that they will have a different effect on tea leaf? If, as I submit, respiratory activity persists in portions of crushed tissue (as caused by normal tea-rolling) independent of any fermentation proceeding at the same time, there appears no need to build up an elaborate hypothesis to account for the carbon dioxide produced during the two co-existing processes.

The higher carbon dioxide output from other tissues (including tea) of itself proves nothing when the wide variation of respiration intensities in different plant species is borne in mind.

Discussing my results with washed and unwashed tissue-mince, Roberts has stated that it is by no means unlikely that in the unwashed tissues the carbon dioxide produced (1) by carbohydrate oxidation in the damaged cells with *o*-quinones as H-acceptors and (2) normal respiration in the undamaged cells inhibited by free (oxidized ?) polyphenols are together equal to the respiration of the washed undamaged tissues now uninhibited by polyphenols. This would mean that the carbon dioxide produced by the *o*-quinone reaction always balanced the inhibition in normal respiration. Such a coincidence in quantitative results is, however, scarcely to be expected in a complex system such as minced tea leaf.

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Oct. 14.

[1] Roberts, E. A. H., NATURE, **152**, 77 (1943).

[2] Sreerangachar, H. B., *Biochem. J.*, **35**, 1106 (1941).

[3] Roberts, E. A. H., and Sarma, S. N., *Biochem. J.*, **34**, 1517 (1940).

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Darwin and 'Water-Bloom'

SOME years ago, I described the formation of red 'water-bloom' in the seas round Cape Peninsular, by myriads of the ciliate *Mesodinium rubrum* Lohmann¹. I had been unable to find references (in the literature available on the spot) to ciliates as a cause of this phenomenon, though 'water-bloom' caused by various other micro-organisms was well known in many localities. A reply from Prof. O. Paulsen² showed that formation of red 'water-bloom' due to Mesodinium had been seen by him at Iceland thirty years earlier. The Danish publication was out of my reach at the time, but I ought not to have missed the astoundingly accurate, detailed description of Mesodinium forming red water made by Darwin³ some fifty years earlier still, before Mesodinium had in fact been named. No one who has examined swarming Mesodinium alive could have any doubt as to the identity of the organisms described by Darwin, and it would be very hard to improve his verbal description.

The red water was encountered by H.M.S. *Beagle* a little to the south of Valparaiso, near the southern boundary of the Peru coastal current, under meteorological conditions precisely the same as those we found to accompany red water at the Cape. My colleague, the late E. R. Gunther, has described discoloration of the sea by living organisms in the Peru coastal current with references up to 1936 in great detail[4], but he also missed this point of Darwin's, and for that I am to blame, for I was trying to help him with microplankton references while he was engaged with other aspects of the work. It is interesting to note further that a second type of 'water-bloom' described by Darwin[3] near the Galapagos tallies almost equally well with Gunther's[4] observation of a yellow patch ". . . due to a swarm of a colonial radiolarian, probably Collosphaera . . . some 180–200 miles off Punta Aguja".

The peculiar conditions resulting in the formation of bottom deposits emitting hydrogen sulphide found off the south-west African coast, farther north than "Discovery Investigations" have proceeded in detail, and described by Copenhagen[5], are analogous to those observed in parts of the Peru coastal current. It will be very interesting to learn whether 'water-bloom' phenomena also extend northwards along that coast so far as the Walfisch Bay area.

Mesodinium is now known to have been a cause of red 'water-bloom' off central Chile in winter[3], in Seydis Fjord, Iceland, in summer[6], off Cape Peninsular in autumn and winter[1], and off British Columbia[7]. There may be other records that elude me under present conditions.

The influence of 'water-bloom' phenomena upon animals of economic importance is at times profound, so it is certain that more research upon them will be needed in the future. It is therefore pleasant to find the origins of scientific treatment of the subject in the work of Darwin, for he must always rank (in the minds of naturalists who ply their trade in deep waters) among the greatest field-workers of all time, whatever his later fame depended upon.

T. JOHN HART.
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The Laboratory, Citadel Hill,
Plymouth.
Nov. 1.

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[2] NATURE, 134, 974 (1934).

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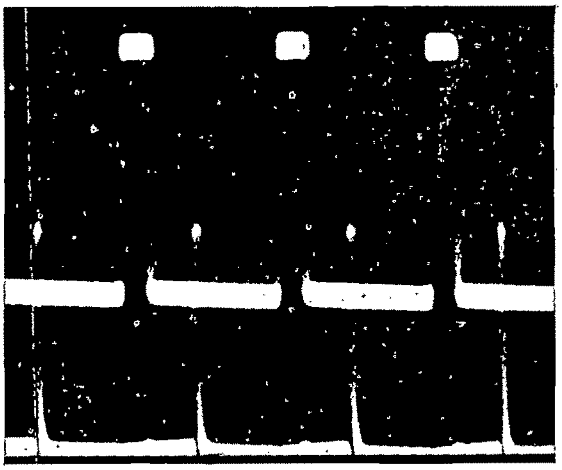
An Oscillographic Method for the Determination of the Velocity of Sound

METHODS of measuring the velocity of sound in air, using the cathode ray oscillograph, have been described by Wold and Stephenson[1], Colwell and others[2,3,4] and by Patchett[5]. Only one precise determination by an oscillographic method has been attempted[4], and the results in this case are of doubtful value since, for example, the influence of humidity and carbon dioxide content of the air have been ignored.



UPPER TRACE—MICROPHONE PULSES. LOWER TRACE—LOUD-SPEAKER PULSES.

The method to which this communication refers is similar in principle to that used by Colwell, but is considered to be capable of greater accuracy. Sound from a loud-speaker connected to an audio-frequency oscillator is picked up by a microphone, which moves on rails perpendicular to the plane of the speaker. The potential difference developed by the microphone is amplified and operated on by pulse-shaping circuits which change its sinusoidal waveform into a series of short rectangular pulses. The output from this arrangement is used to deflect one beam of a double-beam oscillograph. If the microphone is moved along its rails, the pulses travel across the screen and the distance between positions of the microphone at which corresponding points of successive pulses coincide with an arbitrary reference mark is equal to the wave-length of sound at the frequency employed. The reference mark is obtained by connecting the loud-speaker terminals to a separate pulsing circuit, using the output to deflect the second beam of the oscillograph. The trace then has the appearance shown in the accompanying illustration. As the microphone is moved, the upper set of pulses travels across the screen, while the lower series remains stationary. The frequency of the oscillator is checked against that of a standard electrically maintained tuning fork, by continuous observation and adjustment of a Lissajous figure on an auxiliary oscillograph. Frequencies between 4,000 c.s. and 5,000 c.s. have been used, and in this range twenty or thirty values for the wave-length may be obtained by moving the microphone through a distance of two metres.

Preliminary experiments give reason to believe that this arrangement, with minor modifications, may be used for very precise determinations of the velocity of sound in various media. Further research along these lines is in progress.

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Nov. 3.

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[1] Wold, P. I., and Stephenson, E. B., *Phys. Rev.*, 21, 706 (1923).

[2] Colwell, R. C., Friend, A. W., and McGraw, D. A., *J. Franklin Inst.*, 225, 579 (1938).

[3] Colwell, R. C., Friend, A. W., and McGraw, D. A., *J. Franklin Inst.*, 227, 251 (1939).

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Flow of Visco-Elastic Materials in Capillaries

In a previous communication[1] an error in pressure measurement was pointed out, which might lead to spurious results in measuring the viscosity of certain anomalous liquids. Reference was also made to viscosity determinations recently carried out on rubber solutions and the like, using a viscometer in which the true pressure-drop along the capillary was measured directly. The measurements indicated the existence of an end effect, the ratio of the length, L, to the diameter, D, of the capillary, being a significant factor. A typical family of flow curves for one rubber solution, plotted in the conventional manner, is indicated in Fig. 1. These clearly show that if the L/D ratio is sufficiently large, the curves approximate closely to a line which is independent of capillary bore. Smaller L/D ratios give curves diverging from this, indicating a higher apparent viscosity, the divergence increasing as L/D decreases. These curves emphasize the importance of using long tubes, particularly at high stresses, if the results are to be assumed to apply to an equilibrium condition.

This effect, in which long capillaries indicate lower apparent viscosities than short ones, has already been observed for rubber solutions and other visco-elastic materials[2,3]. In order to explain this, we may suppose the material on entering the tube to be 'stretched', or elastically deformed, until equilibrium is reached for the particular shearing stress applied, the material then flowing through the remainder of the tube in this state. For very long tubes, this 'elastic end effect' would tend to become negligible in comparison with the overall length, and flow curves would then give a true, or nearly true, representation of the behaviour of the material under the particular conditions. As the tube length decreases, the end effect becomes large in proportion to the total length, and we should expect a progressive departure from the limiting curve, such as that illustrated in Fig. 1. We should also expect this end effect to increase in magnitude with increasing stress and this would, in turn, accentuate the difference in the flow curves between capillaries of differing L/D ratio. Fig. 1 clearly shows this effect with increasing stress, and further, this end 'correction' deduced from the flow curves and expressed in tube diameters is actually *proportional* to shearing stress. A similar effect ought to occur if the concentration were increased, and this is, in fact, found experimentally. Curves similar to those shown have also been obtained with mineral oils containing metallic soaps.

When the liquid emerges from the capillary it is still elastically deformed and will consequently tend to return to its former 'unstretched' condition. This results in a swelling of the emergent column of liquid which is easily observed, as Fig. 2 shows[4]. It is evident that elastic recovery commences at the actual capillary end. As with the 'elastic end effect', it is to be expected that this swelling will increase both with increasing stress and increasing concentration, and this is found to be so for the materials in question. Here again we find that elastic recovery is *proportional* to stress.

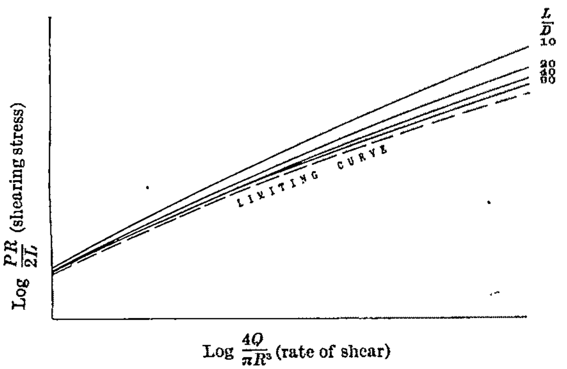

Fig. 1.

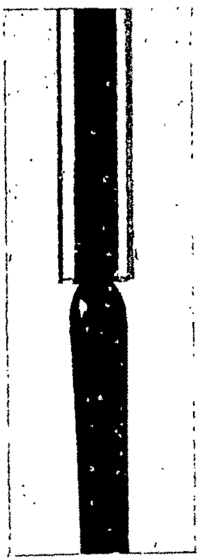
Fig. 2.

In other words, the 'elastic end effect' which results in a difference in the flow curves, and the swelling of the emergent column of liquid, are related, and either should give a measure of the elastic property of the material.

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Sussex.
Nov. 2.

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[1] Merrington, A. C., Nature, 152, 214 (1943).

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[4] Barus phenomenon, *Amer. J. Sci.*, (3), 45, 87 (1893).

High-Angle Edge Flaking of Flint

The recent communications on this subject by Mr. J. Reid Moir[1] and Mr. Alfred S. Barnes[2] show that the old battle over the artificial or natural origin of eoliths is on again. Space does not permit quotation of the opinions on both sides of the original argument starting in about 1912, but it seems to me that, among other things, Moir has proved two important points: (1) that it is possible for modern man to take high-angle flakes off flint cores; and (2) that among other criteria of intentional work on primitive stone artefacts one of the most important is that the edge flakes are taken off in an adjacent series, thus giving an edge of desired shape[3].

As Barnes points out, use was sometimes made of steep flaking in palæolithic work; but he seems to think that primitive man was not likely to use this type of flaking to any great extent. From this he assumes that the frequency of its occurrence on supposed implements can be used as a criterion of their intentional or natural origin. This process of reasoning leads to the danger of arguing in a circle. In any event his analysis[4] of the use of steep flaking in certain palæolithic industries is misleading, as he omits the Aurignacian, in which special use was made of steep flaking, and the Magdalenian, where the removal of flakes from cores can only be done by steep flaking relative to the core.

Now if Moir's criterion is applied to the flaked flints which are claimed by Barnes to have been done by some natural means, especially those from Central

France, Kent and East Anglia, the flaking on a great many of the specimens is seen to be intentional. I have had the opportunity of examining a very large number of specimens from the Upper Miocene (or Lower Pliocene) of Central France, and the systematic edge flaking on most of these seems to me definitely intentional. I have not been able to examine a large collection of Harrisonian eoliths from Kent, but such as I have seen appear to have the same systematic series of flakes. The sub-Crag specimens present rather a different problem, including as they do primitive palæolithic types, but those among them which were partly made by steep flaking again show series of edge flakes which are too systematic to have been done by natural means.

As regards modern experiment, I have had the opportunity of examining specimens of steep flaking done by Mr. Reid Moir, and of watching him remove these flakes with a hammer stone. I have also succeeded in doing the same type of flaking myself, and am convinced that it is not very difficult. It is also relatively easy to take off an adjacent series of such flakes so as to produce an edge of desired shape. My own experiments in making and using various types of stone implements are as yet incomplete, but according to my experience eolithic edge-work is fairly easy to do both on flint and on Bunter pebbles (the latter approximating to Darmsden and Soan types); also various pre-palæolithic types, including rostro-carinates, can be made with practice, involving some use of steep flaking. Experimental copying of Aurignacian and Magdalenian types also shows that flaking at about 90° is necessary for removal of the flakes from the cores. It is my experience that copies of eolithic and pre-palæolithic forms can be used for cutting wood, though they are not so efficient as copies of Acheulean or Clactonian types; I have also found that those made of quartzite do not take as keen an edge as those made of flint, and are therefore less efficient.

It seems to me that recognition of intentional work on flaked stones claimed as primitive implements involves two definite questions: (1) *Could* they have been made intentionally? (2) If so, *could* they have been used for any purpose? As modern man *can* make copies of eolithic and pre-palæolithic types, the answer to question (1) is that these types *could* certainly have been made by primitive man. As such implements can be used, for example, for cutting wood, there would have been some purpose in making the originals. If this is so, the question of a natural origin scarcely arises, and those who may believe in the possibility of such a process will have to explain why certain restricted eolithic forms were made naturally at an Upper Miocene or Lower Pliocene date, to be followed by more diverse and advanced forms in Pliocene and Lower Pleistocene times.

D. F. W. Baden-Powell.

University Museum, Oxford.
Oct. 28.

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[1] Moir, J. Reid, Nature, 152, 78 (1943).
[2] Barnes, A. S., Nature, 152, 477 (1943).
[3] Moir, J. Reid, "Pre-Palaeolithic Man", p. 15.
[4] Barnes, A. S., *Amer. Anthrop.*, 41, 110 (1939).

In his letter in Nature of October 23, Mr. A. S. Barnes says: "The high proportion of high-angle scars in the Tertiary flints . . . suggests that the Tertiary flaking was due to soil movement under pressure arising from solifluxion, foundering, or ice-action". But I think most geologists would agree that these three factors (or at any rate the first and third) were far more active in Pleistocene than in Tertiary times. Why have they failed to produce any comparable effects in the later period? It is an old question, but not less cogent on that account.

Mr. Barnes ignores the evidence of his own figures[1], that there is a connexion between the number of these high-angle scars and the age of the implements concerned; for we pass in percentage from 0 in Solutrean, through 1 in Mousterian, and 5 in Early Acheulean, to 18 in "Chelléen et Préchelléen" (Warren Hill). It is, of course, impossible to construct an accurate graph from these figures, since we do not know the time-intervals involved; but the curve is obviously rising rapidly as we pass from the later and more skilled to the older and rougher work, and it seems by no means impossible that it might rise to 60 or even 70 per cent by the time we reach the Kentish plateau.

It seems unfortunate in this connexion that Mr. Barnes has omitted all mention of the Cromerian flints, and of the "Prechellean" implements of the Zambezi River[2]; for the former might supply some intermediate stages, while the latter are free from all ice-action, and (so far as one can judge by the contours) from any powerful effects of solifluxion and foundering. Admittedly our knowledge of these Zambezi implements is still very imperfect; but until we have fuller information about them, any conclusion along the lines of Mr. Barnes's arguments would seem to be premature.

Henry Bury.

The Gate House,
Alumdale Road,
Bournemouth.

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[1] Barnes, A. S., *l'Anthropologie*, 48, 221 (1938)
[2] Armstrong, A. L., *J. Roy. Anthrop. Inst.*, 66 (1936).

Radio Fade-Out on February 10, 1943

O. E. H. Rydbeck, Chalmers Institute of Technology, Gothenburg, in Nature of June 19, 1943, has requested information about magnetic disturbances on February 10, 1943. At the Magnetic Observatory, Hermanus, where the magnetogram sensitivities were: H, 2·32 γ/mm.; D, 0·534 ′/mm. = 2·20 γ/mm.; Z, 3·69 γ/mm.; disturbances were recorded and published in *Terrestrial Magnetism and Atmospheric Electricity* (June 1943).

Micropulsations, which were little more than a broadening of the D trace, appeared at 07h. 47m. G.M.T., February 10. About three hours later disturbances were recorded on all traces, the D disturbance being greater than the H disturbance, which at this Observatory is characteristic of magnetic disturbances at the time of a radio fade-out. The beginning of the disturbance was not sharply defined. On the H trace the beginning was at about 09h. 45m. G.M.T. and on the D and Z traces at about 09h. 43m. G.M.T. February 10. Seventeen hours later there were abrupt changes indicating the beginning of a magnetic storm. A time interval of 17 hours would indicate a speed of about 1,500 miles per second for the transmission of impulses from the sun.

A. Ogg.

Magnetic Observatory,
Hermanus, C.P.,
South Africa.
Sept. 13.

MEDAL AWARDS FOR 1943 OF THE ROYAL SOCIETY[*]

Copley Medal

THE Copley Medal is awarded to Sir Joseph Barcroft, emeritus professor of physiology in the University of Cambridge, and now the head of a research unit established there in animal physiology.

The researches on the respiratory function of the blood, in respect of which this highest of the distinctions in the Society's gift is awarded this year, have occupied a central position in Barcroft's life-work. Their record is one of steady purpose and unbroken progress over a period of some forty-five years. At Barcroft's own hands, and at those of the long and very distinguished succession of collaborators who have been associated with him, these researches have had many important extensions into neighbouring fields of biological inquiry; they have played a great part n a wide range of recent advances in physiological, biochemical and medical science throughout the world; and they have been an important factor in the creation of a scientific basis for the study of manifold human activities, of work and of play, in peace and in war.

As a newly graduated student at Cambridge, Barcroft seems to have seen already the significance of the problem to which he was thus to devote so many years of fruitful investigation, recognizing the respiratory function of the blood as a condition of the life and a measure of the metabolic activity of every part of the body of the higher animals. With a cumbrous equipment of pumps and their accessories, alone available for such determinations in those early days, he applied himself with great determination and ingenuity to a study of the changes of oxidative metabolism which accompany secretory activity in the salivary gland. From that beginning his researches grew and developed in logical sequence, including studies of oxidative metabolism in relation to specific activity in the kidneys, the liver, the muscles and other organs, with various excursions to deal with corollaries from this central theme.

Early in the series came Barcroft's invention of a comparative manometric method, which effected a revolutionary simplification of the technical operations involved in obtaining the data required. The same method enabled him, in due course, to make his classical redeterminations of the relation between the pressure of oxygen and its combination with, or release from, blood or solutions of hæmoglobin, and of the effects of varying conditions on the graphs representing that relation. The principle of this method, as employed either in Barcroft's own original apparatus, or in the more delicate micrometric form which Warburg later introduced, has passed into standard use in every laboratory of functional biology throughout the world, for measuring rates of respiratory metabolism in surviving samples of living tissues and of various chemical changes due to artificial enzyme systems. Barcroft and his companions in research have used it, in expeditions which he led to Monte Rosa and to the Andes, to study the modifications of man's physiology by life at high ltitudes and at low oxygen tensions, providing knowledge which to-day has an ever more urgent application to the problems of human flight; and in two successive wars Barcroft himself has used the knowledge built up and the skill acquired in his peaceful researches to the direct aid of his country in its need.

Studies of the differences between the respiratory functions of the blood in fœtal and independent life led Barcroft, with a characteristic readiness to follow the lead of natural interest, into a neighbouring field of inquiry, to a more general study of the physiology of mammalian fœtus, and thus to the results which he reviewed in the Croonian Lecture of 1935 on "Fœtal Respiration". His need, for that purpose, to make observations on larger animal types, such as the sheep, led again to a wider interest in the physiology of farm animals, and so to the new enterprise for which his more recent research appointment provides welcome opportunity.

In a preface to his book, Joseph Barcroft finds a connexion between what he learned in sailing boats and what he has done in research. We may think of him, perhaps, as one whose instinct and aptitude have led him to venture as an explorer beyond visible horizons, rather than to sound remoter depths of theory in seas already known. Such a thought would place him in a long tradition of this Society, in company with such great students of the respiratory function as Boyle, Hooke, Mayow and Lower among our earliest fellows, and, of those who over the centuries have received this Copley Medal, with Stephen Hales and Joseph Priestley and, most intimately of all, with John Scott Haldane, who received it nine years ago. Barcroft's work, like Haldane's, of high scientific merit in itself, has extended its influence far beyond the laboratory over a wide range of the beneficent and creative activities of mankind at peace, and now again, for the last time let us hope, to those imposed by the dire compulsion of war. We rejoice to know that in him the hunger for knowledge is still unsatisfied, and that he is still sailing his craft towards new horizons.

Royal Medals

A Royal Medal is awarded to Sir Harold Spencer Jones, Astronomer Royal for England, in recognition of his determination of the solar parallax and of other fundamental astronomical constants.

Much of the earlier work of Spencer Jones was devoted to the discussion of certain fundamental astronomical constants, and in this field of work he was long ago recognized as a leading authority. At the meeting of the International Astronomical Union held at Leyden in 1928, a Solar Parallax Commission was appointed, with Spencer Jones as president, in preparation for the favourable opposition of the minor planet Eros in 1931.

The planning and co-ordination of the enterprise of redetermining the solar parallax, in which twenty-four observatories took part, fell mainly upon him, and he was entirely responsible for the assemblage of the material, and for the derivation of the results. It is to be noted also that the Cape Observatory, of which he was then director, made the greatest contribution to the observational material. The circumstances of the opposition favoured southern observatories, and the plates obtained at the Cape contributed more weight than those from all the other observatories combined.

The whole task of reduction of the observations was carried out under Spencer Jones's supervision, and the memoir which contains the complete discussion of the material and the results obtained from it (*Mem. Roy. Astro. Soc.*, vol. 66, part 2; 1941) is a masterly exposition of the whole subject of the investigation of solar parallax and of the interrelated constants.

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[*] Remarks made by Sir Henry Dale in presenting the awards on November 30.

The solar parallax finally derived is given as 8·790 ± 0·001, as compared with the value of 8·806 ± 0·004 obtained by A. R. Hinks at the preceding opposition of Eros in 1900–1. Spencer Jones found complete agreement between the results derived separately from northern and southern observatories, or from right ascensions and declinations separately, or from photographic and photovisual telescopes, or from primary and secondary stars, as well as from four successive periods of time during the opposition. No matter how the material was subdivided, no substantial difference could be found in the value of the solar parallax derived. There is thus every reason to think that systematic error has been eliminated, and that the probable error of 0·001 truly represents the high degree of accuracy of the final result. Therewith we are given a new estimate of the earth's distance from the sun, which is likely to stand without revision for many years. These observations on Eros also yielded a new estimate of the mass of the moon, which has less than half the probable error of the previous determination.

The modification of the previously accepted value of the solar parallax affects the estimates of other astronomical and geophysical constants. Spencer Jones's work is enhanced by his discussion and general adjustment of the values of all these interrelated constants, and in this he makes a substantial new contribution to the problem to which so much of his earlier work was devoted.

A Royal Medal is awarded to Dr. E. B. Bailey, director of the Geological Survey of Great Britain, in recognition of his contributions to the knowledge of mountain structure and his studies on the tectonics of vulcanism.

The number, range, and importance of Bailey's contributions to geology can have few parallels in the history of this science in Britain. It is only necessary to review his major publications to recognize the solid achievements that stand to his credit in the diverse fields of petrography, tectonics, stratigraphy, glaciology and physiography. But it is more particularly by his outstanding contributions to the knowledge of mountain structure and on the tectonics of vulcanism that he is to-day acknowledged internationally as a leader.

His work on mountain structure is contained in a long series of memoirs on the non-fossiliferous schists of the Southern Highlands of Scotland. These studies, prosecuted far across country and presented in a brilliant synthesis of the structure over a large part of the south-west and central Grampians, mark a great advance in the field of mountain tectonics and have provided a notable stimulus to research on Highland geology.

Bailey's now classic researches undertaken in conjunction with Clough and Maufe on the Devonian volcanic cauldron subsidence of Glen Coe, and his early work on the petrology and classification of the Carboniferous volcanic rocks of the midland valley of Scotland, were stepping-stones to the immense task which he set himself in later years in the island of Mull. It is these investigations which have revolutionized our knowledge of the inner structure of British volcanoes; for to them we owe the recognition of ring dykes and ring complexes and the conception of igneous intrusion by ring fracture stoping.

Bailey's insatiable zest for scientific research has led him into other fields, and among notable contributions to Scottish geology must be reckoned the work he carried out with Kendall on the glaciation of East Lothian and the additions he made to the knowledge of the physical geography of Millstone Grit, Kimmeridgian and Cretaceous times. Farther afield his studies have dwelt on the tectonics of the Pennsylvania Piedmont and on the seismic origin of submarine canyons of the continental slope: and he has shown the importance to be ascribed to submarine landslips in the past record of the rocks, notably in the Palæozoic succession of Quebec.

Throughout a long and active career Bailey, by his enthusiasm, his powers of observation and his interpretative insight, has rendered splendid service to the science of geology, and his record of achievement is unsurpassed among living British geologists

Davy Medal

The Davy Medal is awarded to Prof. I. M. Heilbron, professor of organic chemistry at the Imperia College of Science and Technology, in recognition of his many notable contributions to organic chemistry especially to the chemistry of natural products of physiological importance.

After some early researches dealing with the chemistry of the coumarins, chromanes and benzopyrylium salts, Heilbron made his first really important contribution by his well-known investigation on the remarkable hydrocarbon, squalene, which occurs in certain fish oils. Almost simultaneously he established the structures of batyl and selachy alcohols. His interest in fish oils being thus aroused he next turned his attention to vitamin A. He attacked this problem in the first instance by the use of the spectrograph with the collaboration of Morton, who was thereby led to develop methods for the quantitative estimation of this vitamin, which hav since proved invaluable. Heilbron's contribution to the chemistry of vitamin A earned him an international reputation, and later led to the recognition of vitamin A_2. He has attacked also the difficul problem of the synthesis of vitamin A and, although it has not yet reached its objective, his work in thi direction has raised many points of great interes and importance.

Heilbron has also made notable contributions to our knowledge of the sterols and triterpenes. In this field, following pioneering work on the structure of ergosterol, he provided an elegant proof of the structure of vitamin D_2 (calciferol) and has elucidated the structures of lumisterol, fucosterol and, mor recently, zymosterol. In the triterpene field his most notable contribution has been his discovery of th key alcohol, basseol, which, in view of its facil conversion into β-amyrin, seems likely to play a significant part in the classification of triterpen chemistry.

The outbreak of war interrupted Heilbron's projected study of the lipochromes and sterols of the algal classes, a study likely to be of importance not only to the chemist but also to the botanist, for whom it may provide a new basis of classification. A résumé of this work formed the subject of a Hug Müller lecture to the Chemical Society. Britis chemists are indebted to Heilbron more than to an other chemist for the introduction into Great Britain of the most refined new techniques. He has used extensively in his researches chromatographic absorption, microanalysis and high-vacuum distillation, while he was probably the first to recognize the potentialities of absorption spectra as a research tool. His influence has thus spread far beyond the circle of the many research chemists trained in his laboratories.

Sylvester Medal

The Sylvester Medal is awarded to Prof. J. E. Littlewood, Rouse-Ball professor of mathematics in the University of Cambridge, in recognition of his mathematical discoveries.

Among mathematicians, the name of Littlewood will always be associated with that of G. H. Hardy for the wonderful example of perfect teamwork in their fashioning of a new and rare instrument of mathematical precision during the second and third decades of the twentieth century. Into the theory of numbers, that subject where problems are so easy to state but so hard to prove, an entirely new spirit was nfused when the methods of analysis were brought to bear upon it. The credit for attaining the highest results, for perfecting the methods, and for inspiring an enthusiastic following among so many of the noblest mathematicians at home and abroad, all belongs to Hardy and to Littlewood. Littlewood, who is by age the junior in this remarkable partnership, brought his own magnificent contribution, as Hardy himself has wholeheartedly testified. Littlewood, on Hardy's own estimate, is the finest mathematician he has ever known. He was the man most likely to storm and smash a really deep and formidable problem: there was no one else who could command such a combination of insight, technique, and power.

Littlewood's work covers a wide field of pure mathematics, extending from his fundamental discoveries in the realm of integral functions (1908) up o the present date. It was a happy event when Ramanujan, with his intuitive genius, proposed problems that brought out the fullest powers and skill of Littlewood and Hardy and their analytical heories. We can have no doubt that there is a peculiar fitness in the immediate succession of Littlewood to Hardy in this triennial award of the Sylvester Medal for mathematical research.

Hughes Medal

The Hughes Medal is awarded to Prof. M. L. E. Oliphant, Poynting professor of physics in the University of Birmingham, in recognition of his work on nuclear physics and mastery of modern methods of generating and applying high potentials.

Oliphant, initially under the general guidance of Rutherford, has made fundamental advances in the ield of nuclear disintegration. With the aid of pecially designed apparatus he has produced intense beams of protons and of the nuclei of heavy hydrogen, with homogeneous energy, the study of the reactions of which with light nuclei has proved very fruitful. The intensity of the beam which Oliphant has obtained has allowed effects to be produced at much lower voltages than had hitherto been available. The theoretically important disruption of the lithium nucleus has been investigated with particular care. In this connexion a separation of the two lithium isotopes was first effected, so that they could be separately studied, with a consequent greater certainty as to the reactions.

In Oliphant's researches the energy liberated in certain nuclear reactions has been measured to a remarkably high degree of accuracy, and the laws of conservation of mass-energy and of momentum have been verified. This is a matter of great importance for the understanding of nuclear reactions, and has also enabled the masses of the light atoms to be calculated very precisely.

As a result of work carried out by Oliphant with Harteck, on the bombardment of the nuclei of heavy hydrogen with like nuclei, two new light isotopes have been discovered, one of hydrogen and one of helium, both of mass number 3. The nuclear reactions of beryllium and of boron have also been carefully investigated.

In the published accounts of the work Oliphant's name has often been associated with that of others, including Rutherford, but there is no doubt that he was responsible for the very specialized experimental technique, as well as for other contributions to the collaborative enterprise. Oliphant has been particularly successful in the design of apparatus. Besides that required for the researches to which reference has been made, he has been responsible for the development of the two-million-volt installation at Cambridge. During the War he has successfully carried out work of great importance. His fine record of achievement is fittingly recognized by the award of the Hughes Medal for "original discovery in the Physical Sciences, particularly electricity and magnetism or their applications".

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Saturday, December 4

GEOLOGISTS' ASSOCIATION (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. Alan Wood: "Basic English and its use in Geology" and "Organs of Reproduction in the *Solenoporaceæ*".

SHEFFIELD METALLURGICAL ASSOCIATION (joint meeting with the SHEFFIELD SOCIETY OF ENGINEERS AND METALLURGISTS and the IRON AND STEEL INSTITUTE) (at the Royal Victoria Station Hotel, Sheffield), at 2.30 p.m.—Discussion on the Fourth Report of the Oxygen Sub-Committee.

Monday, December 6

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. W. A. Robertson: "Timber—the Minor Products" (Cantor Lectures, 3).

SOCIETY OF CHEMICAL INDUSTRY (LONDON SECTION) (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Prof. W. E. S. Turner, F.R.S.: "Glass for Use in the Chemical Industry"; Mr. I. C. P. Smith: "Sintered Glassware—Manufacture and Uses".

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 8 p.m.—"Geography of Post-War Air Routes" (Discussion to be opened by Lieut.-Colonel Lord Brabazon; and Film, "Singapore to London").

Tuesday, December 7

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—Mr. L. Bohdanowicz: "The Polish Tartars".

INSTITUTION OF CIVIL ENGINEERS (RAILWAY ENGINEERING DIVISION) (at Great George Street, Westminster, London, S.W.1), at 5 p.m.—Mr. H. R. Reynolds: "Soil Mechanics and the Railway Engineer"; Mr. M. F. Barbey: "Some Soil Mechanics Problems on the L.M.S. Railway".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. J. C. Drummond: "Food Problems of the Post-War Years", 3: "Food Technology".*

Wednesday, December 8

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. A. C. Bossom, M.P.: "Some Modern Methods of Construction Practised in America".

INSTITUTE OF FUEL (at the Connaught Rooms, Great Queen Street, Kingsway, London, W.C.2), at 2.30 p.m.—Major-General K. C. Appleyard: "The Production and Use of Open-Cast Coal".

Thursday, December 9

Royal Institution (at 21 Albemarle Street, London, W.1); at 2.30 p.m.—Prof. W. Perceval Yetts: "Links between Ancient China and the West: a Study of Exchanges in Material Culture", 3: "The Quest of the Superior Horse".*

Pharmaceutical Society (at 17 Bloomsbury Square, London, W.C.1), at 7 p.m.—Mr. Arthur Mortimer: "The Ministry of Supply and its Relation to the Pharmaceutical Industry".

Friday, December 10

Royal Society of Arts (India and Burma Section) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. H. S. L. Polak: "India and American Opinion".

Oil and Colour Chemists' Association (Manchester Section) (at the Grand Hotel, Manchester), at 2.30 p.m.—Dr. V. G. Jolly: "The Progress of Paints and Painting".

Royal Institution (at 21 Albemarle Street, London, W.1), at 5 p.m.—Prof. H. W. Florey, F.R.S.: "Penicillin: its Development for Medical Uses".

Institution of Mechanical Engineers (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Dr. S. L. Smith: "A Survey of Plastics from the Viewpoint of the Mechanical Engineer": Mr. J. Lionel Daniels: "Moulding Plant for Plastics".

Institute of Physics (London and Home Counties' Branch) (at the British Institute of Radiology and Rontgen Society, 32 Welbeck Street, London, W.1), at 6 p.m.—Dr. E. H. Rayner: "The Electron Microscope".

Saturday, December 11

British Mycological Society (at the Linnean Society, Burlington House, Piccadilly, London, W.1), at 2 p.m.—Dr. S. P. Wiltshire: "The Organization of the Study of Systematic Mycology".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Lecturer in Histology in the Department of Physiology—The Registrar, King's College, Newcastle-upon-Tyne (December 8).

Engineer and Manager of the Edinburgh Electricity Corporation—The Town Clerk, City Chambers, Edinburgh (December 10).

Demonstrator (man or woman) **in the Chemistry Department**—The Warden and Secretary, London (Royal Free Hospital) School of Medicine for Women, 8 Hunter Street, Brunswick Square, London, W.C.1 (December 10).

City Engineer and Surveyor—The Town Clerk, Town Clerk's Office, St. Albans (endorsed 'City Engineer') (December 10).

Museum Curator—The Acting Clerk, Letchworth Urban District Council, Council Offices, Letchworth (December 11).

Woman Education Officer to teach Mathematics or Geography in African Boys' Secondary Schools or Teacher Training Schools, Tanganyika Territory—The Secretary (I.P.R./C.A.), Board of Education, Belgrave Square, London, S.W.1; or (for candidates in Scotland), The Secretary, Scottish Education Department, 29 St. Andrew Square, Edinburgh 2 (December 15).

Lecturer in High Voltage Engineering, and an **Assistant Lecturer in Mechanical Engineering**—The Registrar, College of Technology, Manchester 1 (December 31).

Superintendent to take charge of section of works in South Yorkshire engaged in the manufacture of Laminated Railway Springs—The Ministry of Labour and National Service, Appointments Office, The White Building, Fitzalan Square, Sheffield (quoting Reference No. A.O. 222).

Deputy Director of Tools under the Government of India—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.1949A).

Geologist in the Colonial Geological Survey Service, Nigeria (Reference No. F.1801), and a **Geologist** (temporary) under the Government of British Guiana (Reference No. F.1802)—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Alexandra House, Kingsway, London, W.C.2 (quoting the appropriate Reference No.).

Colonial Engineer and Surveyor-General for the Government of Dominica Public Works Department—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. E.821A).

Assistant Master or **Mistress** (temporary) **for Science and Mathematics**—The Principal, County Technical College, Stoke Park, Guildford.

Laboratory Assistant in the Electrical Engineering Department of the Municipal Technical College—The Director of Education, Education Offices, Oldham.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Agricultural Research Institute of Northern Ireland. Sixteenth Annual Report, 1942–43. Pp. 30. (Hillsborough: Agricultural Research Institute of Northern Ireland.) [2110

Ministry of Agriculture and Fisheries. Growmore Bulletin No. 8: Substitute Feeding Stuffs. By Dr. John Duckworth. Pp. 16. (London: H.M. Stationery Office.) 3*d.* net. [2110

Educational Reconstruction: Notes on the White Paper issued the Board of Education. Pp. 12. (London: Association of Scienti Workers.) 3*d.* [221

The Public Library Service: its Post-War Reorganization an Development. Proposals by the Council of the Library Associatio Pp. 16. (London: Library Association.) 6*d.* [25

Looking Forward: the Sigmund Apprentice Training Schem Pp. 20. (Gateshead-on-Tyne: Sigmund Pumps (Great Britain Ltd.) [27

Selected Papers from the Royal Cancer Hospital (Free) and t Chester Beatty Research Institute. Published by order of the Governo of the Royal Cancer Hospital (Free), London. Vol. 2. Pp. viii+41 (London: Royal Cancer Hospital (Free).) 16*s.* [28

Sheffield City Libraries. Research Bulletin No. 8: A Select Bibli graphy on Foundry Practice. Pp. 26. (Sheffield: Central Library 3*d.* [29

Ministry of Fuel and Power Industrial Bulletin. Economy Measur to be Observed in the Use of Lubricating and Industrial Oils. Pp. 1 (London: Ministry of Fuel and Power.) [29

Proceedings of the Royal Society of Edinburgh, Section B (Biology Vol. 61, Part 4, No. 31: Hair Pigmentation and the Genetics Colour in Greyhounds. By Marca Burns. Pp. 462–490+1 plat (Edinburgh and London: Oliver and Boyd, Ltd.) 2*s.* 9*d.* [11

Other Countries

National Research Council. Bulletin No. 106: Handbook of Scie tific and Technical Societies and Institutions of the United States an Canada. Fourth edition. United States Section compiled by Call Hull and Mildred Paddock; Canadian Section compiled by S. J. Coo and P. A. Howard. Pp. 390. (Washington, D.C.: National Academ of Sciences.) [2

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THE SOCIAL SCIENCES IN GREAT BRITAIN

ON what may perhaps be the eve of real measures of social reconstruction, the conclusions of the Committee on Scientific Research on Human Institutions appointed by the British Association are welcome. For if, as Mr. Churchill has said, it is a definite part of the duty and responsibility of the National Government to have its plans perfected in a vast and practical scheme to ensure food, work and homes after the War, research into the most efficient plans to form into such a scheme must be started forthwith. This research itself must be "vast and practical" and must integrate the work of natural and of social scientists. Representatives of both persuasions were members of the Committee, which consisted of Prof. P. Sargant Florence (chairman), Mr. L. J. F. Brimble (hon. secretary), Mr. H. J. Braunholtz, Prof. G. Catlin, Prof. C. H. Desch, Mr. A. Farquharson, Prof. J. C. Flugel, Prof. Morris Ginsberg, Prof. Lancelot Hogben, Dr. Julian Huxley, Prof. Harold Laski, with the President and General Officers of the British Association. Thus the Committee included a chemist, three biologists, a psychologist, an economist, an anthropologist, two sociologists and two political scientists. The detailed terms of reference point straight at the close connexion of social research and governmental plans. The committee was "to consider how the results of scientific research on human institutions and human needs and their interrelations can best be co-ordinated and brought to bear on the formation of public policy".

Any committee of the British Association, with its sections devoted both to the natural and to the social sciences, must start by dealing clearly with the differences and similarities in the research of these two groups of disciplines. The difference is seen in the fact that the recognized natural sciences, including even physical anthropology, do not deal with the contact of man with man. To study these essential contacts the report envisages a sociology dealing with types of human association and organization and their functioning through the "operation of law, morals and religion in society and of other forms of social sanctions and control, including the economic price mechanism".

But the similarities of the two groups of sciences are greater than is usually assumed both in the method employed and in the material it is employed upon. "Both natural and social sciences", to quote the report, "are concerned with qualitative as well as quantitative methods. . . . Both employ deduction, classification and induction and take no account of values", except in so far, presumably, as the origin of values is a proper topic of scientific interest. The similarity of method is indeed becoming more evident now that both natural and social sciences are making wider use of statistical techniques. Economists are becoming less content to rely on deduction from self-evident axioms. They summarize factual data into index-numbers and 'multipliers', and are applying precise measurement to the national income. Occasionally even political scientists indulge in realistic surveys such as casting the proportion of public school men in British Cabinets. Social psychology in its studies of vocational selection, industrial fatigue and the like has always employed statistical methods, and social biology and demographic studies such as the measurement of the localization and structure of the industrial population are statistical in very essence.

Though the subject-matter of the social and natural sciences is different, there are many lines of research on the border of the two, in the pursuit of which workers both sides the border should co-operate. Social medicine, dignified by the recent creation of chairs at the Universities of Oxford and Birmingham, is a case in point; and the translation of new engineering techniques into the plans and planning organization of a factory should be another borderline study linked to the demographic problem of industrial location. A third borderline picked out by the Committee is that of social biology and social psychology. These deal with (1) the genetic basis of human behaviour, the influence of the quantity and quality of the population on social structure, and the converse influence of the social structure on the quantity and quality of the population; (2) the needs and wants of man, his preferences and aversions, motivation and educability in various types of social organization, the distribution of abilities and problems of recruitment.

The new emphasis on training of teachers for school biology with a view to national health, sponsored by the Central Council for Health Education and other official or semi-official bodies, points to another direction in which our universities will have to make provision for closer contact between naturalistic studies and social statistics.

The post-war problems discussed by officially appointed committees have been grouped into the physical lay-out of homes and of industry; and social security, either by providing the conditions for work and health or, at second best, compensation for unemployment and disability. All these problems, against which the Government is presumably making plans, require research for their successful handling and, in particular, co-ordinated research among the natural and social sciences. An efficient physical lay-out involves knowledge of geology, geography and engineering as well as the economic characteristics of industry. A successful plan for social security calls for knowledge of food values, vital statistics and the possibilities and limitations of the political and administrative set-up; and both a successful home and a successful security policy involves a knowledge of people's habits and ways of thinking that is by no means given to the individual sociologist and psychologist without systematic and objective research among the masses.

Clearly the interrelation of the natural and social sciences and their application to public policy are a two-way traffic. Greater knowledge of natural phenomena makes its impact on social organization; but the needs, wants and abilities of man require that human institutions make—in reverse—their own impact felt. It is a commonplace that new applications of natural science without appropriat social controls have led to mass unemployment monotonous labour, derelict industrial areas an concentration of economic power detrimental t community values.

What, then, are the practical measures that shoul be taken to implement the social research that i required as a basis of public policy ?

First and foremost, more importance should b attached to the social sciences in the form of endowment of certain branches of social research. It i sometimes thought that social research can be carrie on cheaply because little is required in the way o apparatus and laboratories. This is a profoun mistake. The major expense even in the natura sciences is made up of salaries for research personnel and the social sciences, if they are to base conclusion on a sufficient field of objective observation, statistically measured, will certainly need a large skille staff. Natural scientists are justifiably contemptuou of the armchair type of thinking by social scientists But if the sociologist is to leave his armchair for th field he must have trained armies at his command He cannot, in the complex situation that social lif presents, rely on a few select observations. H cannot reduce expenses by controlled experimen under laboratory conditions. So far from bein cheaper, effective social research is likely to prov more expensive than research in the natural science There is, of course, some justification for th economist who complains of the uninspired collectio of facts of trivial importance without guiding hyp thesis. Much expense can be saved by armchai thought, and co-ordination of working hypothesi with statistical fieldwork is a prime necessity. Bu however happy the marriage of theory and statistic the family budget is likely to run high.

Next to endowment, research on human institution needs, it is clear, close co-ordination.

It is mainly for this purpose that the Britis Association Committee proposes the setting up of Council for the Social Sciences. This Council woul co-ordinate the direction of research and the disbursement of funds, would initiate and supervis practical training and advise the Government on th preparation of official statistics in a fruitful form For it is on data collected by the Government tha factual social research must often rely; and all to often such research is frustrated by ill-conceived c inconsistent classification and tabulation. If an when the necessary expenditure is forthcoming, suc a Council might well carry with it the responsibilit for planning co-ordinated inquiries of social importance within the framework of a university development council.

Finally, social research needs the means fo publicity if it is to be brought democratically to bea on public policy. For this purpose, the Committe proposes the formation of a society for factual socia research in addition to the co-ordinating Counci Such a society would be formed on the lines of learne societies in the natural sciences, thus again illustratin the importance of mutual help and advice betwee the sciences, social and natural.

FUNCTIONAL COLLABORATION IN WORLD AFFAIRS

THE survey of the activities of the Middle East Supply Centre which appears in the centenary mber of the *Economist* is a valuable contribution the discussions at present centring on the value functionalism as a factor in promoting inter- tional collaboration. The success which has tended concentration on particular problems and e ease with which co-operation has been secured r some specific purpose, as the Hot Springs Con- rence showed, have suggested that functional -operation may be a means of persuading the wers ultimately to make the wide sacrifices in tional sovereignty which the preservation of peace ll demand. The Middle East Supply Centre is a ece of functional international machinery which s been evolved empirically and could be main- ined in its own area after the War. It serves a tural regional grouping, which is overwhelmingly ab, the industrial development of which has arcely begun. The States are fiercely nationalist d the very fact that the Middle East is a microcosm akes its experience of value as a model for similar ntres elsewhere.

While the war-time work of the Centre is chiefly regulate the flow of supplies into the area in the terests of war economy, it needs little imagination see the vital purpose which this simple piece of nglo-American organization could serve after the ar. Its staff is predominantly technical, scientific d young. Their chief work is to serve as a centre information and contact, to advise, instruct and ncourage the local authorities and to be, as it were, e guiding intelligence for the whole area. Already this way the Centre has been a general trans- tter of agricultural projects and improvements, cilitating the passage of successful experiments in ricultural development from one area to another. r example, it was only after the establishment of e Supply Centre that the excellent system of aling with the menace of the goat to afforestation Cyprus was brought to the notice of the Syrians, d successful experiments in growing seed potatoes ve been extended from Malta and Palestine to her Middle East States.

This pooling and exchange of information is sup- rted by surveys carried out by experts from the ntre into local conditions of agricultural production, th comments on how they could be improved. The ntre has also arranged for the provision of agri- ltural machinery, and important schemes of igation have been sponsored. Three of these are ing operated in Persia, another is under discussion r the headwaters of the Euphrates, while in Syria scheme which had been considered for years was rried through by the 61st Tunnelling Company of e South African Army at the request of the Middle st Supply Centre. Locust control is another ample of international action planned through the ntre. Research has established the fact that these vastating insects execute a regular nomadic cycle rough the Middle East, wintering in Southern Persia, to return through Iraq, Syria and Egypt to Abyssinia. No one Government could ever have dealt with this vicious circle, but the Middle East Supply Centre has been able to bring all the interested States together and achieve the essential co-ordination. Under the direction of Dr. B. P. Uvarov in London and with the assistance of the R.A.F. and the Red Air Force, exterminating crusades, operating from the air and on land the length of the Red Sea and up through Persia and Iraq, hold promise that for the first time in history the plague may be brought under control.

Medical services provide another example, and here the experience of the International Health Organisation of the League of Nations had already pointed the way. Apart from the standardization of drugs and equipment, the Middle East Supply Centre has resulted in official medical services coming in contact, in the R.A.M.C. and the American services, with some of the finest medical minds of Britain and the United States. The standard of public health has already been raised in this way, but scourges such as malaria offer opportunities for far more to be done.

These examples and others such as the creation of new industries or the assistance given to transport can scarcely fail to suggest to the scientific worker the value of the Centre after the War as a pool for all kinds of economic, social and technical services. In an area starved of technical efficiency, expert assistance would be always available without onerous political or economic conditions attached to its use, although the Governments concerned should be expected to contribute something in return for the advice they receive. Beyond this, the Centre would also be a planning headquarters. Its experts would conduct regular surveys of areas or problems and advise the Governments on the best methods of solving their difficulties. Any problem which was beyond the competence of the local authorities or involved two or more Governments could be referred to the Centre for expert opinion. It needs little imagination to realize the immense contribution which the Centre could make in such ways through energy, guidance and clear thinking. Irrigation schemes, roads, power, artesian wells, industrial development, all crossing and recrossing national frontiers, could, as the *Economist* truly observes, give a unity to the Middle East which five generations of pan-Arabism could not achieve, if indeed it did not provide the kernel of effective political unity.

The significance of a Centre of this type, beginning as a piece of effective machinery for regional planning, co-operation and research, and stretching out to regional health services, transport authorities, public utilities, industrial and agricultural development boards, is not confined to its adoption, more or less modified, as a model for other centres and as a stimulus to functionalism. It has a profound bearing on the whole development of colonial policy and planning. The article in the *Economist* rightly stresses the opportunity which this functional approach to the problem of pooling sovereignty offers to Britain, and the need for her to concentrate not on the export of business men and traders but on experts, technicians, medical men and scientific workers, who combine her great and humane traditions with the scientific and technical skill the twentieth century requires. The point was indeed made by Flexner in his discussion of English universities, when he emphasized the need of the British Commonwealth for trained men of wide disinterested cultural and scientific training, who could conduct organized attacks on the problems, practical and philosophical, of modern life. In that way might well come the creation of new markets, through the raising of standards of living everywhere, and the transition in Britain to a new industrial system based on high-grade products and services. But if colonial problems are no longer to be a stumbling block in international relations, if the question of access to raw materials is not to become academic, if commonwealth and empire are to be synonymous terms, colonial policy must take full account of these functional developments and turn them to the most effective use.

Much the same idea of functional development permeates the plea for imperial development on a much larger scale which is the essence of H. W. Foster and E. V. Bacon's "Wealth for Welfare". In urging the establishment of an imperial development authority which might be a prelude to an international authority, and would be organized on the lines of the public utility corporation, the emphasis is placed on the need for a factual approach, for continuity of policy and for adequate financial support. Whether in dealing with the economic development of a particular area such as British Honduras, which they use to illustrate their argument, or in describing the broad and more general work which might be entrusted to the proposed development authority, Messrs. Foster and Bacon stress the need for adequate research and experiment as a first stage. This must be the prelude to any extensive planning, and their suggestion that an exploratory research and development company should be formed first to acquire the knowledge and experience on which the organization of a permanent development authority could later be based, is characteristic of their outlook.

This scientific approach affords a sound basis for the conviction of Messrs. Foster and Bacon that economic development of the British Colonial Empire on lines primarily designed to promote welfare, and with resources and a long-term policy which will permit the cumulative benefit of the measures initiated to be reaped, is sound financially. What is striking is the extent to which their policy is already reflected in action. An article in the current number of the *Round Table* shows how the Hot Springs Conference has made an important addition to the technique of diplomacy and strengthened the collaboration of the United Nations. In a field where political action is also required to secure the solution of a technical or economic problem, it has done much to clear the way—so much that we might well encourage the idea of technical conferences as opposed to conferences of plenipotentiaries for clearing some of the ground in post-war problems.

Again, it is probable that the food organization is likely to serve as a source of technical and scientif advice to any commodity council set up by the Unite Nations as a political body to take executive actior and to secure a position of authority as an imparti source of information and advice in agricultural ar nutritional matters may well be the most importa part the food organization could play. By pr viding a meeting-ground for the expert and a foru for the discussion of matters of common concer and by conducting expert inquiries or undertakin at the request of governments or groups of gover ments, such a body would be invaluable in furtheri the aims of the Hot Springs Conference, irrespecti of the progress which may be made in organizi economic relations internationally in more gener fields.

The three notes struck in "Wealth for Welfar are equally clearly reflected in Colonel Oliver Stanley recent statements and speeches and in Governme action. In regard to research, for example, t Colonial Economic Advisory Committee recent established under the chairmanship of the Duke Devonshire to advise the Secretary of State matters of economic policy in relation to the Coloni dependencies, particularly matters of general poli arising out of programmes of economic developmen follows naturally on the Colonial Research Committ appointed last year under Lord Hailey as chairma It should also be remembered that Nuffield Colle is at present engaged on a three and a half ye scheme for research into economic and constitution questions in British tropical Africa. A Committee Colonial Studies set up to co-ordinate and advan these studies and an Institute of Colonial Studi financed by Nuffield College, are among four furth steps recently taken by the University of Oxford develop Colonial studies. Again, the importance comparative studies of labour problems as a field research is well brought out by Dr. Margaret Reid a paper, "Migrant Labour in Africa and its Effec on Tribal Life", in the *International Labour Revi* (**45**, No. 6 ; 1942) which has recently been reprinte Dr. Reid's preliminary survey shows how labo demands of an alien economic enterprise have co pletely undermined the old economic life of Nyas land and threaten its social life as well.

Colonel Stanley has explicitly recognized t importance of a factual basis for broad lines economic policy, and he has emphasized in a spee in the House of Commons on July 13 and also el where the necessity for liberal expenditure on colon development ; like Messrs. Foster and Bacon, appears to be convinced of the value and importan of such expenditure on an adequate scale. He rec nizes to the full the opportunity which the Colon Development and Welfare Act offers, and his wor on this point are the more important because insists that economic development must be link with educational advance, and that the two toget form the twin pillars upon which any sound scheme political responsibility must be based. This wo appear to be the only way of combining the sta of trustee with that of partner.

Colonel Stanley rightly pointed out that the spre of elementary education in the Colonies is a necessity for every social improvement; every economic development in some measure demands an increase of knowledge among the people. New health measures, the improvement of agricultural methods, new co-operative machinery for production and distribution, and the establishment of secondary industries, make demands on the Colonial peoples for co-operation to which they can only respond when they have educational opportunities. The Commission of Inquiry into higher education in British West Africa under Mr. Walter Elliot, Mr. Justice Asquith's Commission of Inquiry into the whole question of university training in the Colonies, and the course for training in leadership of co-operative societies at the London School of Economics, are the natural concomitants if the expenditure of large sums from the Colonial Development and Welfare Fund contemplated by the Colonial Secretary is to bear full fruit.

On the question of regional developments, Colonel Stanley was as explicit as on this functional approach. While he recognizes that the detailed planning must be done on the spot, he stated that the experience already gained by the Anglo-United States Caribbean Commission has led the Government to contemplate nore permanent machinery in which all the common oroblems of an area could be discussed. The Government would welcome the establishment of such machinery as the establishment of commissions for regions comprising not only the States with colonial erritories in the region but also other States which iave a major strategic or economic interest in the egion. While each State would remain responsible or the administration of its own territory, such a ommission would provide effective and permanent machinery for consultation and collaboration in promoting the well-being of the colonial territories, nd with this work the people of the colonial terri-ories in the region should be associated.

Colonel Stanley has thus associated himself with n idea to which General Smuts and Lord Hailey ave given some prominence, and in the debate in the House of Commons Sir Edward Grigg stressed the pportunity in such international collaboration of ssociating the self-governing Dominions with the dministration of the British Colonies. Even though the full responsibility of the tutelary Power of actual dministration of a particular territory is unimpaired, there are clearly difficulties in regard to such roupings, as the slightest review of any possible roupings in Africa, for example, will show. None the less, the experience of the Middle East Supply entre as well as that of Anglo-United States o-operation in the Caribbean has already indicated ossibilities which must be explored. If we keep entral direction to the planning of the broad schemes, ensuring continued, long-range planning and the provision of adequate resources, both in finance and n personnel, and entrust the elaboration and execu-on of detailed schemes to the local administration, e may best ensure the co-operation and interest of the individual communities and their leaders. At ast it is clear that the co-operative attack on articular problems and the planning of resources to that end, independent of artificial political boundaries, may prove an indispensable step in the mobilization not merely of our scientific resources for the wise development of these untapped sources of agricultural or mineral wealth, but also in securing that widespread human interest and understanding without which no plans for the attack on disease, on ignorance, on malnutrition or on poverty can be pushed to a successful conclusion.

TWO GREAT ARCHÆOLOGISTS

Time and Chance

The Story of Arthur Evans and his Forebears. By Joan Evans. Pp. xi+410+15 plates. (London, New York and Toronto: Longmans, Green & Co., Ltd., 1943.) 21*s.* net.

THIS is rather the saga of a family than a biography of an individual. Out of a genealogical welter (considerately illuminated by two family trees on the end-papers) of Evanses, Dickinsons, Grovers, de Brissacs, and several other families, there emerges first the Rev. Arthur Benoni Evans, a somewhat ineffective schoolmaster with artistic tastes, and an incipient collector of coins; then John Evans, who combined great efficiency in his Uncle Dickinson's paper-making business with first-class pioneer work in palæolithic archæology and in numismatics; and thirdly, Arthur Evans, whose career as an amateur insurgent in Dalmatia and an omnivorous collector in many fields culminated in a blaze of glory as the discoverer of the ancient civilization of Minoan Crete. Along with these there are sketches of Anne (Dickinson), the capable wife who saved Arthur Benoni's ramshackle career from disaster; of John Evans' three wives, and his brother Sebastian, "impecunious, versatile, and happy", who took after his father in lack of practical effectiveness but achieved some reputation by his translation of the "High History of the Holy Grail"; and of Arthur's brother, Lewis, whose fine collection of mathematical instruments adorns the Old Ashmolean building at Oxford. All these characters are admirably handled by Miss Evans, with a lightness of touch and a flavour of humour which commend and set off her mastery of her material.

The two outstanding figures, however, are, of course, John and Arthur, father and son, alike in their taste for antiquities, and in a flair in collecting which amounted almost to genius, but unlike in temperament and career. John worked hard in his somewhat unsympathetic uncle's business, earned wealth, position, and a high reputation as a forceful member of countless committees and councils; and, as a sideshow, took a leading part in the earliest discoveries of palæolithic man, was a first-rate numismatist, became president of the Society of Antiquaries, the Numismatic Society, and the Geological Society, vice-president of the Royal Society, and a trustee of the British Museum, and filled his house with collections of all sorts of beautiful and interesting objects.

Arthur was far less a man of business, was something of a rolling stone and strongly individualist, but equally a born collector and an archæologist gifted with singular insight and initiative. After a fairly successful career at Harrow, where he got prizes for Greek epigrams, English essay, and English verse, but made few friends, and a first class in history at

Brasenose, which failed to lead to a fellowship, he started in 1871 to explore Europe. He was financed by his father, and at no time troubled himself much about earning money, though he was glad to make something by contributions to the *Manchester Guardian*. From the first his affections were won by Dalmatia. He set his heart on Ragusa as a residence, visited the Balkans every year, and when in 1878 he married Margaret, daughter of E. A. Freeman, he almost immediately took her out there. Since 1875 he had been up to the eyes in Balkan politics, then exceptionally (even for them) perturbed. He was actively engaged in fomenting insurrections against Turks and Austrians, and writing fervid letters to the Press to denounce the oppressors. This was in the long run too much even for the comparatively easy-going Austrians (if the Prussians had been administering Herzegovina, it would probably have led to a firing party), and it ended in seven weeks' imprisonment at Ragusa in March–April, 1882, and a decree of expulsion from Austria. (It was currently reported in Oxford at the time that he was liable to be shot at sight if he set foot in the country again.)

Evans did not enjoy imprisonment, and thenceforth (apart from a somewhat farcical episode in 1909, when for a few months he was a Liberal candidate for the representation of the University in Parliament) he turned from politics to archæology. He pitched his tent in Oxford, and in 1884, by good fortune, the keepership of the Ashmolean fell vacant, and he was elected to it. Here was an opportunity, and Evans was the man for it. Archæology to him meant a great deal more than classical Greek art. The Ashmolean needed overhauling from top to toe ; he saw his way to making it a first-class museum of archæology, and (not without friction and combat and some hard words) he made it so. The new Ashmolean, now one of the first archæological museums in Great Britain, is very largely Evans' work.

But Oxford was not wholly congenial to him ; and a greater opportunity awaited him. Miss Evans makes a good deal of play with the phrase, 'Time and Chance' ; but in truth 'the Hour and the Man' would be more appropriate. So it had been with the Ashmolean ; but in 1897 the hour was that of the liberation of Crete from Turkish control, and the consequent possibility of excavation there ; and the man was Evans. For some years he had had his eye on Crete. He divined that there was something to be found there ; and he found more than he divined. He went to find writings in an unknown script, of which he had seen specimens on some seals ; and he found a kingdom, the kingdom of Minos, the predecessor of Mycenae, and the earliest phase of Hellenic or proto-Hellenic culture.

This is not the place to retell the story of the excavation of Knossos. In 1908 Evans inherited the properties of his father and his cousin, Tom Dickinson, and thenceforth he was a wealthy man, and able to carry out his work in his own way. What he made of it is to be seen at Knossos (if it escapes the hands of the vandals), and is recorded in the seven sumptuous volumes of "The Palace of Minos". Not until 1935 did he finally leave Crete, to pass the final years of his life at the house he had built on Boars Hill. Here, in 1941, his ninetieth birthday was celebrated by a deputation from the Hellenic Society ; and here, three days later, he died, full of years, riches, and honour.

Miss Evans is to be thanked and congratulated for the manner in which she has told the story of th
family, of which she is herself not the least distin
guished member.

F. G. KENYON.

MICRO-ORGANISMS IN EVERYDAY LIFE

Microbiology and Man

Being an Account of the Diverse Properties an
Characteristics of Micro-organisms, a Description o
the Various Tools and Techniques for their Handling
and an Inquiry into their Subtle Relationships t
Everyday Life. By Prof. Jorgen Birkeland. P
x+478. (Baltimore, Md. : Williams and Wilkins Co.
London : Baillière, Tindall and Cox, 1942.) 22*s*.

THIS book covers a very wide field, and appear
to have been written with the definite purpos
of attempting to serve as a basis for an understandin
of the part played by micro-organisms in everyda
life. It is divided into sections dealing with th
fundamentals of microbiology, infection and resis
ance, common infectious diseases and the micr
biology of food, milk, water, sewage and soils. Whil
it is too technical even for the instructed layman an
too diffuse for the student of specialized disciplin
in this extensive field, it is, nevertheless, a mos
readable and informative book, which should serve t
stimulate the student's interest and perhaps help hi
to decide the trend of his future studies. If the boo
falls into the hands of the non-technical reader th
extensive glossary of terms employed will be foun
extremely helpful ; but his subsequent readin
would have been much assisted if even a sho
bibliography had been appended.

There are some notable omissions from the text. I
the discussion on cholera, for example, there is n
mention of the serological grouping of vibrio
including the "El Tor" vibrios, differentiating th
Inaba type from related strains ; the serologic
classification of the Flexner dysentery group
passed over in silence, and in the reference to th
Weil-Felix phenomenon no account is given of th
part played by the 'Kingsbury' strain of *Prote*
(*Proteus XK*) in the serological diagnosis of mit
borne typhus (Tsutsugamushi and scrub typhu
The statement that all members of the genus Coryn
bacterium are parasites and are found closely ass
ciated with the skin of man or animals cannot pa
without comment. Not only are several speci
implicated in phytopathogenic conditions (for e
ample, *C. michaganense*, the cause of bacteri
cancer of tomatoes), but the researches of H.
Jensen have shown corynebacteria also exist as s
saprophytes.

Following the lead of Bergey's "Manual", t
author places *Salmonella sanguinarum* in the gen
"Shigella", although it is serologically identical wit
and culturally similar to, *Salmonella pullorum*, and
included in the genus Salmonella by the Salmone
Sub-committee of the Nomenclature Committee
the International Association of Microbiologists.

It is unfortunate that there are many printe
errors in the text. To cite a few examples, *Bruce*
abortis is given for *Brucella abortus*, *Pasteure*
tularense for *Pasteurella tularensis*, *Streptococ*
scarlatina for *Streptococcus scarlatinæ*, and *Salmone*
abortus avi for *Salmonella abortus ovis* ; also in t
names of authorities, Ogston, Kitasato, Muckenf
and Vasco da Gama are misspelled. The discove

of the causal organism of Malta fever (*Brucella meli- ensis*) is said to be Sir Robert Bruce and not Sir David. Here is a possible confusion with Robert the Bruce, whose field work, so tradition relates, was oncerned with fundamental studies on the habits of the Arachnidæ and not with micro-organisms!

Some of the historical notes are most entertaining and do much to enliven the pages of Prof. Birkeland's olume. One feels, however, that the author is appiest in the concluding chapters of his book, ealing with microbiology of food, milk, water, ewage and soils. The chapters on microbiology and ater and on sewage reach a high standard of clarity and excellence.

R. ST. JOHN-BROOKS.

ENGINE RESEARCH

he Chemical Background for Engine Research

dited by R. E. Burk and Oliver Grummitt. rontiers in Chemistry, Vol. 2, published under the spices of Western Reserve University.) Pp. xii+ 97. (New York: Interscience Publishers, Inc.; ondon: Imperia Book Co., Ltd., 1943.)

N recent years increasing attention has been paid to ways and means of keeping students and dustrial scientific workers abreast of advances in ose branches of fundamental research which have application to their work; and facilities are now ailable which, although still imperfect, have gone long way to meet the requirement. The publication classified abstracts, for example, is an essential rvice to this end, the value of which is unquestioned. addition, the compilation of progress reports and ecial monographs affords a means of supplementing e abstracts by periodic critical reviews of con- mporary work. It is thus possible, in most in- ances, to obtain a reasonably comprehensive count of the present state of knowledge in any rticular branch of science without a laborious arch through the literature.

The volume under review represents a contribution the latter category of publications. It originates a project sponsored by Western Reserve University bringing graduates into personal touch with ups of distinguished workers in selected fields, to ar first-hand of the researches in progress and of directions in which significant advances are being de. The lectures given by the various groups are erwards published in a series entitled "Frontiers Chemistry". Two volumes have appeared so far itled, respectively, "The Chemistry of Large lecules" and "The Chemical Background of Engine search".

The six contributors to the latter volume, E. F. ck, F. D. Rossini, F. C. Whitmore, G. von Elbe, Lewis and O. Beeck, are well known in Great tain for their pioneer work on the physical and mical properties of hydrocarbon fuels generally l on the internal combustion engine, and their sidered views on engine research therefore con- ute an important contribution to the literature of subject. The scope of the lectures is compre- sive, and includes methods of synthesis of complex rocarbons, a clear summary of their combustion racteristics, recent theories of combustion, chemi- thermodynamics of hydrocarbons and physico- mical aspects of lubrication. To the student of bustion the lectures by Fiock, von Elbe and Lewis are of particular interest in that they assemble all the relevant experimental data relating to the oxidation of hydrogen and the simpler hydrocarbons and proceed to show how the observed phenomena may be fitted into a general theory of combustion. The result is not entirely satisfactory. Indeed, Fiock, in his second lecture, states ". . . it may truthfully be said that not a great deal is actually known of the highly complex mechanism by which the chemical energy latent in the combustible mixture is transformed into usable mechanical energy"; and the reader will probably come to the same conclusion.

The shortcomings of the theory, outlined in von Elbe's contribution, arise partly from the fact that in no single instance have the combustion characteristics of a hydrocarbon been determined experimentally over the full range of reacting mixtures, and partly owing to a tendency to cling to the simple mechanical analogy which came into vogue in the early days of the atomic and kinetic theories.

In considering any mechanisms for combustion, it is necessary to distinguish clearly between ascertained fact and surmise. Experiment in general only gives information as to the identity of stabilized products which survive when a reacting medium is suddenly chilled; it gives no accurate data as to the instantaneous composition of the medium at any stage of the combustion. In consequence, kinetic data based upon chemical analysis or observations of changes in pressure are difficult to interpret save in the case of slow reactions between simple molecules. There is, however, strong evidence that combustion processes involve, in many instances, an orderly interchange of energy of a specific kind represented in the mechanical analogy by the links of chains, either single or branched; and to account for the kinetic data it is now customary to identify the chains with the formation of free radicals by the initial dissociation of the reacting molecules, and their subsequent interaction with other radicals, atoms or molecules in a series of elementary chemical reactions.

As to the composition or even the existence of free radicals in such circumstances, experiment tells us little. Indeed, von Elbe points out that in the case of any particular hydrocarbon "the reactions considered to be of consequence are selected because by means of the kinetic theory of gas reactions they yield equations which, after introducing certain numerical values, correctly describe the dependence of explosion limits and reaction rates on the experimental variables pressure, temperature, vessel diameter, mixture composition, and nature of the surface; and because no alternative, or at least no plausible alternative schemes yield the correct relation. There is no method known by which the individual chain-carrier reactions may be studied independent of each other".

It will be clear from the above that much exploratory work of a fundamental character yet remains to be done before a generally acceptable theory of combustion can be formulated.

In conclusion, it may be well to remove the impression that the lectures deal solely with the more recondite aspects of combustion theory. They have, in fact, a strong practical trend, and give adequate emphasis to experimental methods and to such important factors as engine 'knock' and lubrication. The book is well illustrated, and useful bibliographies are given by each contributor.

D. M. NEWITT.

OPTICAL TOPICS IN PART CONNECTED WITH CHARLES PARSONS*

By The Right Hon. Lord RAYLEIGH, F.R.S.

The Parsons Family, and Parabolic Mirrors

PARSONS belonged to a type peculiarly British. We have been called a nation of amateurs, and probably most Englishmen when they repeat the phrase do so not altogether without complacency. So far as the saying has any definite meaning, I think that Parsons' character and methods of thought go to exemplify it. This may seem to some a paradox, and no doubt the building of a twenty thousand kilowatt turbo-alternator, together with the accompanying technique of drawing office, patent specification, licences to outside manufacturers, and so on, seem very far from the amateur workshop and its atmosphere. But these huge machines, on which the industrial prosperity of whole districts may depend, had their prototypes in the constructions of wire, paper, cardboard and sealing wax, which could be seen on the mantelpiece of Parsons' study in Mayfair. What I want to convey is that though Parsons was thoroughly informed as to the conventional procedures of engineering, he had no superstitious reverence for them, and was if anything biased in favour of doing something different, if there was even a possibility that it might be an improvement.

The Hon. Sir Charles Parsons, O.M., K.C.B., F.R.S.

Parsons' father, the third Earl of Rosse (1800–67), was, like his son, a man of mechanical genius, and it is a matter of interest to trace the relation between the careers of the two men. The portrait of the father, in the rooms of the Royal Society, is strongly reminiscent of the son as I knew him. The aspect is mild and beneficent: and in Charles Parsons' case strangers who, without knowing their man, presumed unduly upon it, were apt to receive a rude awakening.

Lord Rosse's great telescope of 6-ft. aperture was built with only amateur resources and the assistance of estate carpenters and workmen from the local rustic population taught by himself. The records of his work in telescope construction were collected and reprinted by his son[1], and it is easy to see in this volume the hereditary source of Charles Parsons' mechanical genius. The spirit and mentality of the son's work are closely traceable in that of the father. Lord Rosse's great telescope was notable in the history of astronomy for the discovery of the spiral structure of the extra-galactic nebulæ; and, as we can now see, there were not a great many other problems for which it would have been suitable. The great modern reflectors owe their usefulness to their accurate driving clocks, and to the mode sensitive plate. In Lord Rosse's day, these thin were still in the womb of the future. I rememb discussing his father's work with Parsons, and expressed the opinion that, given his financi resources, and given the contemporary state development of the mechanical arts, it would scarce have been possible for him to do more. He told that the sum expended was of the order of £10,00 This, of course, brought no financial return, nor c it have been expected to do so, in spite of the fa that the elder Herschel had made a living by t sale of the reflecting telescopes which he constructe

Judged by the precedents of those days, and by t then value of money, £10,000 was no doubt a ve large sum to spend on astronomical equipment, a possibly some contemporary critics may have thoug that the discovery of the spiral structure of t nebulæ was an inadequate return for it. If, howev we recall that this discovery was a fundamental o for the general structure the universe which, broad speaking, is believed to co sist entirely of such nebu to the number of perha 10^{10}, we may see things in truer proportion. It may a be illuminating to think of t cost even of a minor warsh of to-day, and to compare with the cost of Lord Ross telescope.

Some have perhaps gain the impression that Lo Rosse's interest was more the construction of the te scope than in the use of It may be admitted that one who had not been carr on by keen interest in mechanical processes wo have been able to get throu such a task. On the ot hand, it would be wrong suppose that the possibilit of the completed instrum were not adequately made of. Lord Rosse tells us th for a period of seven years after the construction the telescope, few favourable opportunities observing with it were lost. The conditions of were very unlike those of a modern instrument; it was only maintained fit for use by periodically polishing the speculum metal mirror, which requi a skill comparable with that of the original figuri

It is not perhaps over-fanciful to suggest t Lord Rosse's telescope bore the same kind of relat to the great telescopes of to-day that the three-dec of his day bore to the modern ocean steamship. each case the machine was effective for its purp and could do wonderful things in skilled ha Ropes, chains, pulley blocks, carpentry and bla smith's work took the place of precision engineer Far inferior mechanical resources were available the construction, and far more was demanded in way of personal skill and muscular effort from user. This is the rule of progress. No though person considers that the effort represented by obsolete machines was wasted, for they were ne sary steps on the road. The results obtained them gave the needed stimulus for fresh efforts b ater generation, and brought into view the problems which remained to be faced.

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* Parsons Memorial Lecture delivered before the Physical Society on October 15.

The modern telescopes of to-day are among the highest developments of precision engineering. In Lord Rosse's day precision engineering as we know t scarcely existed; indeed, the word itself was of comparatively recent origin, those of the craft still being often called millwrights. Lord Rosse belonged o the transitional period when modern precision engineering was in the process of birth, and among his friends were some of the main contributors to it; for example, Charles Babbage (1790–1870), whose calculating machine, though never completed and representing much wasted intellectual effort, was the means of greatly raising the standards of precision in mechanical construction.

The records of Lord Rosse's work on telescope construction, some of which were not very accessible, were collected and reprinted by his son towards the end of the latter's life, and those who knew Charles Parsons can easily trace in the volume the hereditary ources of his mechanical genius. The same spirit and mentality pervades both. Neither of them had much literary gift, and their titanic achievements are described in a matter-of-fact style designed simply o tell what they have to tell without any desire to make a fine story of it. I recall many years ago that Charles Parsons, in giving me a copy of "The Evolution of the Parsons Steam Turbine", by Alexander Richardson[2], said, in a half-apologetic way, "It is rather a florid sort of a thing". Looking at the book again, I do not think it is, in fact, open to this criticism. All that can fairly be said is that Parsons' mechanical triumphs are described by Richardson in a style not quite so reserved as Parsons' own.

Charles Parsons can have had comparatively little opportunity of learning directly from his father, who died when he was only thirteen years of age. The astronomical and mechanical traditions of the family were carried over the intervening period by Charles Parsons' elder brother, the fourth Earl of Rosse 1840–1908), who, though not perhaps possessing quite the tenacity of purpose of his father or of his younger brother, had a considerable measure of the same kind of gifts. He was best known for his observations on the radiant heat of the moon.

Lord Rosse's great interest in the problems of optical construction was fully inherited by his younger son, Charles Algernon Parsons. The most practical fruit of these researches was in the manufacture of searchlight mirrors. He developed a method of making these which, from the scientific point of view, was an interesting new departure and which moreover proved a commercial success, though it has been overshadowed by his work in other fields.

The idea of using the electric arc for a searchlight goes back to days before the development of the dynamo machine, when a large number of Grove cells was the source of current; and there are indications in the literature that inventors were at work from that time on. The concave mirror necessary for hrowing out a parallel beam may be made of metal or of glass. Metal was used in some early projectors by Siemens, and it was readily shaped into a deep parabolic form by spinning or otherwise. The surface was gilded. Metal searchlight mirrors, though occasionally revived, are now almost obsolete, at any rate in Great Britain, owing to the inferiority of reflecting power, and the difficulty of maintaining it good under service conditions. In this respect, silver under glass is far superior, but to make a deep mirror of glass and of accurate parabolic form at a reasonable price was a matter of no small difficulty.

Convex and concave spherical mirrors of glass silvered at the back were no novelty. They were used as ornaments from a very early time. Thus, in Van Eyck's portrait of Jan Arnolfini and his wife in the National Gallery, painted in 1434, a convex mirror hanging from the wall reflects the contents of the room. Large mirrors of this kind became fashionable as ornamental furnishings towards the close of the eighteenth century. There is a fine example mounted as a convex mirror in the library of the Royal Institution. The diameter is 28 in., and it is 'silvered' with amalgam on the concave side. This mirror can be seen in the well-known engraving of a group of leading scientific men of the day gathered in the same room in the year 1807.

Such mirrors were and are given their preliminary shape by gradually heating up the glass disk, and allowing it to sink by gravity into a concave mould as soon as the glass becomes soft. They are then annealed and after cooling are ground and polished with spherical tools, in the same way as lenses are ground and polished.

Such spherical mirrors are, however, of very limited use for searchlight work. To get brightness it is necessary to take up from the arc a cone of light having a large angle and make it parallel. If we attempt to take up a cone of, say, 60° by extending a shallow spherical mirror of given radius so that it becomes deep, the additional light is not sent where we want it, but finds its way out laterally, away from the axis of the beam. This is the effect called spherical aberration, and it soon sets a limit to the useful angle of the cone of rays which can be collected by a spherical mirror. On the other hand, the optician, accustomed to produce accurate spherical surfaces of glass by the well-tried and effective method of abrading them with circular strokes on a spherical tool, is reluctant to abandon the spherical form. In 1874, Col. Mangin, of the French Engineers, devised an ingenious method of extending the usefulness of spherical surfaces. This amounts in effect to making the glass into a concave meniscus lens, and silvering the back surface. We may regard such an arrangement as a concave spherical mirror covered with a concave meniscus lens. Remembering that the parabolic form is the ideal, it is evident that the outer zones of a spherical mirror tend to converge the rays too much compared with the inner zones. The superposed zone of the concave lens tends to diverge the rays and with increasing effect in the outer zones. By a suitable choice of curvatures these effects can be made very nearly to compensate one another, provided that too deep a mirror is not aimed at. In this way the spherical aberration is corrected, while the constructional advantage of spherical surfaces are retained.

Such is the nature of Mangin's invention, which in its day was extensively used, and especially in France from about 1882 until 1921. Parsons is said to have regarded it with some favour, though I do not remember to have heard him on the subject. These mirrors were, however, expensive to make, and the necessary thick edges made them heavy and liable to crack with the heat of the arc. The principle did not admit of a very favourable ratio of aperture to focal length, and this ratio did not usually much exceed unity.

So far we have only considered spherical glass mirrors, and previous to 1886 no other glass searchlight mirror had been made. The mechanical problem of making a parabolic searchlight mirror of deep curvature has of course little in common with the problem of parabolizing a telescope mirror, which is of such shallow curvature that the parabolic form can be derived from the spherical by local polishing towards the middle.

Charles Parsons appears to have turned his attention to searchlight mirrors so early as 1886, when he was with the firm of Clarke, Chapman, Parsons & Co. He was probably led to do so by the family tradition of making reflecting telescopes, but it must be remembered that he was also concerned with the manufacture of electric lamps. He devised a method of making good parabolic mirrors of silvered glass at a cost which was not too great. This method had many points of novelty and was kept a close secret for years, only a few trusted employees in the Heaton Works and a few personal friends of Charles Parsons being privy to it. However, as in all such cases, it leaked out in the end, and after the War of 1914–18, when the demand for searchlight mirrors had for the time fallen to a very low ebb, it had become widely known, and Parsons told me that he no longer regarded it as a secret.

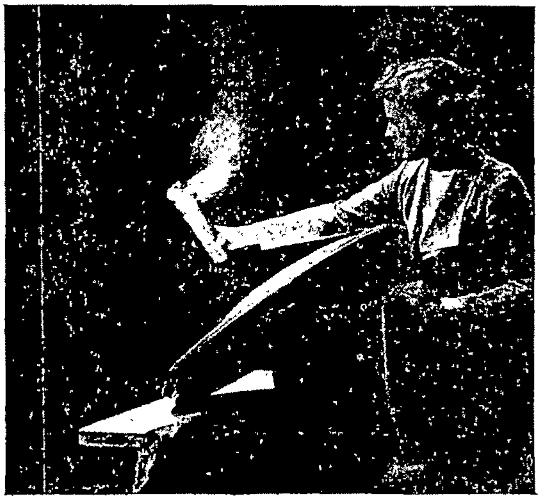
This method so far resembled the old traditional method of making convex and concave spherical mirrors already mentioned, that the flat glass was bent into a curved form by moulding from a flat disk at the lowest temperature which will make it plastic. I am inclined to think from the way Parsons spoke to me that he had re-invented this process and did not realize, any more than I did myself, that in its cruder form it was an old one. There is not much, if anything, to be found about it in print, either in its old or its newer form. Parsons' improvements consisted in using a disk of plate glass, already ground and polished to flat surfaces, and pressing it between cast iron moulds or formers, accurately turned to a paraboloidal surface. In a later improvement the concave former was alone used, and the softened glass was brought into close contact by applying a vacuum through a small hole in the metal. After annealing in a gas-heated oven, the surface was fine-ground and polished a second time. Since the surface was now paraboloidal, this could only be done by spherical grinding and polishing tools of small size. These tools could only be an approximate fit for the local curvature of the paraboloid, but the polisher, being of felt, had some power of adaptation to the surface on which it rested.

A process of this kind could not, of course, produce an absolutely certain result, and each finished mirror was tested optically with the help of a collimating lens, by determining the focal length of each separate zone, screened off from the remainder. This resulted in a certain percentage of rejections.

One of these mirrors in a wooden frame, which formerly hung on the staircase of Parsons' country house, Ray, near Kirkwhelpington, Northumberland, is now in my possession. It is of plate glass, $\frac{1}{4}$ in. thick. The diameter is 24 in. and the focal length $17\frac{1}{2}$ in. The depth of the concavity is more than 3 in.

Much larger mirrors than this one were made, up to 7 ft. in diameter. Even the 2-ft. mirror, taken out into the sunlight and used as a burning glass, will readily set a large log of green wood on fire.

About the same time that Parsons developed his method of making parabolic mirrors, the firm of Schuckert in Germany was attacking the same problem in a different, but in some respects a mor obvious, way. They, too, probably moulded th glass approximately to the desired shape. Thei subsequent process amounted in effect to turning th glass on a vertical lathe, the lathe tool being a smal rotatory grinder, and the motion transverse to th lathe axis being guided by mechanism which cause the small rotatory grinder to follow the desire parabolic path. There is little or no informatio available in Great Britain beyond the meagre account given in patent specifications, and only those wit practical experience of both could fully decide th relative merits of this process and the process o Parsons. The criterion of cheapness in the finishe product was very much in favour of the latter, an if I judge rightly it will probably appeal to mos engineers as the more mechanical method of the two In either way the parabolic form is attained b turning on a lathe, guided by suitable mechanism but while Parsons did this operation once for all o the metal former, Schuckert did it on the glass fo each individual mirror. So far as the results go, i appears that the necessary accuracy of figure can b attained by either method. This accuracy is, o course, of an altogether lower order than is necessar for telescope mirrors, where the figure must no depart from the paraboloid by more than a fractio of a wave-length at any place.



PARSONS' 2-FT. PARABOLOIDAL MIRROR USED AS A BURNING GLASS.

The Mangin mirrors, which were necessarily thic at the edges, were probably made by grinding ou the concavity, but they were very expensive.

To make a thin paraboloidal mirror of deep curvature out of a solid disk by grinding the material awa would be a barbarous proceeding; like whittlin away a large tree trunk in order to make the shaf of a spear, as the Australian aborigines are said t have done. Owing to the depth of curvature, th difference between the spherical and the paraboli form is too great to be attained by the tentativ methods used for parabolizing reflecting telescope If glass is to be used at all in place of metal, we ar practically limited to moulding it while soft, a Parsons did. It is not, perhaps, certain that he wa the first to produce an approximate parabolic for in this way. What he certainly did do was to carr out this moulding process with the greatest possib accuracy, and to use the parabolic form thus produce to guide the subsequent operation of fine grindin and polishing. This feature appears to have been entirely new. It was not patented, and he kept it secret as long as he could, probably judging that a more effective protection would be obtained in this way*.

During the later years of his life, Parsons became keenly interested in the production of large glass disks for reflecting and refracting telescopes. In the case of reflectors, he had a number of original ideas, and his mind was full of the subject right up to the day of his death.

As it seemed to me, he regarded Heaton Works, of which he was practically the sole owner, partly indeed as a money-making concern, but also largely as a source of personal pleasure, and a place where interesting and amusing large-scale experiments could be tried. The attitude was rather that of progressive landowners like Coke of Norfolk early in the nineteenth century towards their estates and farms. Parsons' successors, who had to consider their shareholders, could not carry on in this spirit and had to abandon experimental projects which were liable to fail, and which in any event did not hold out the hope of large profits. The result was that this epoch of bold experiments in the field of telescope-making at Heaton ended with Parsons' death, many projects of some promise having to be abandoned. One or two of them may be mentioned. Thus, in the case of reflecting telescopes, the problem was to make disks large enough for the projected 74-in. mirror for the University of Toronto and the 200-in. mirror for the Carnegie Institution. No definite orders had been received for these, but the chance of receiving the order naturally depended on the proof of ability to carry it out.

The largest glass mirror than existing was the 100-in. of the Mt. Wilson Observatory, which is 13 in. thick and was made from a disk supplied by the St. Gobain Plate Glass Company. This had only been produced with difficulty, and Parsons looked round for some easier method than that of casting the mirror at one operation. He reflected that there would be no difficulty in cutting disks of this diameter and of moderate thickness from commercial plate glass. Could not a number of such disks, carefully cleaned and placed in a pile, be fused together at a moderate heat ? We may recognize here a certain kinship to the general line of thought which had led to his method of making parabolic mirrors, again by the use of moderate heat. A number of trials were made on a comparatively small scale, and some of them were successful. Thus, for example, four circles of ¾-in. plate glass, 17 in. in diameter, were united into a single disk 3 in. thick, by heating to 650° C.

These experiments suggested another idea. A cellular glass disk is, of course, much lighter than a solid one, and is not necessarily much less rigid. The fusion method seemed to lend itself to this, and was tried with some success. In one experiment two circles of ⅜-in. plate glass 12 in. in diameter, separated by a layer 1¾ in. thick of granulated glass, were heated to 650° as before. The whole became welded into a coherent disk, which behaved satisfactorily. Larger experiments of the same kind were made, but without full success. It is not clear, however, that the limitations of the method (if any) were established.

In spite of these fairly encouraging results, Parsons seems ultimately to have preferred a rather different method. In one experiment he used three disks of optical flint glass 9½ in. in diameter by 1 in. thick, the adjoining faces having been previously ground flat and polished. This assembly was raised to fusing temperature and flowed out into a disk about 11½ in. in diameter and 2 in. thick. This appeared to be to all intents and purposes a solid disk. It seems that this experiment gave a satisfaction and confidence that the other experiments had not given. It was Parsons' intention to make the 76-in. disk for the Toronto reflector by this method, but owing to his death and its financial repercussions the work was not carried out, and the Toronto mirror was ultimately made of Pyrex glass by the Corning Glass Co. of New York. It was, however, ground and polished at Heaton.

Newton and the Dark Lines of the Solar Spectrum

I have tried to recall, as was fitting, something of the history and spirit of one part at least of Charles Parsons' activities*. I turn now to another optical topic which has no direct connexion with him, and which is scientific rather than practical. If he were still with us it would without doubt have found in him a sympathetic listener.

Telescopes and spectroscopes, as we ordinarily know them, depend upon the use of lenses, and as the subject is usually expounded, it might seem that lenses were of the essence of these instruments. My thesis will be that it is not so, and that a telescope or spectroscope of fair performance can be set up without the use of lenses. The foundation is in work done by my father before I was born. I hope to be able to add a few points to it.

In preparing an address for the recent Newton Tercentenary, the question presented itself: What minimum conditions are necessary for observation of the Fraunhofer lines in the solar spectrum, and how was it that Newton when he examined the solar spectrum in 1672 onwards failed to observe them ? It may seem that this should be a fairly simple question. Several eminent authorities have given their opinion upon it, but, as will be shown, they have not given a correct answer. This will lead on to the question of how far lenses are essential in the telescope or the spectroscope. It will be shown that a telescope can be constructed without lenses (or mirrors) which is fairly adequate for examining the degree of 'solar activity' as measured by the size and number of sunspots. It will be shown further that a suitably designed spectroscope with a single prism of ordinary flint glass and without lenses will show the Fraunhofer lines in the solar spectrum. Naturally, in discussing so well worn a theme as the simple spectroscope, one can only hope to say anything of novelty on a few points. On the other hand, the subject is not so specialized as to be overgrown with refinements which appeal only to the few.

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* In a pamphlet entitled "The Theory of Searchlights" (anonymous) published by H.M. Stationery Office on behalf of the War Office in 1935, it is stated that

> "The first practical reflectors of paraboloid shape were made by Messrs. Chance who pressed the glass into shape without grinding the surface. These were inferior to the Mangin type."

This, if correct, would be the nearest approach to an anticipation of Parsons' invention. I communicated with Messrs. Chance, but their director of research, Dr. W. M. Hampton, who kindly looked into the matter, was unable to find any evidence that they had made parabolic mirrors in this way previous to 1935.

* I gave my personal recollections of him in a paper which was printed as an introduction to "Scientific Papers and Addresses of the Hon. Sir Charles A. Parsons", edited by the Hon. G. L. Parsons (Cambridge, 1934).

The first experiments on the spectrum which Newton described in the *Philosophical Transactions* in 1672 and afterwards in his "Optics" were made by passing a beam of sunlight which came from a small hole in the shutter through a prism placed close to the hole, the spectrum being received on the opposite wall. He regarded this arrangement as producing a series of images—what are now called 'pinhole' images—of the sun in the various colours, though he did not himself use this expression, and indeed the hole he used was one third of an inch in diameter. Subsequent writers of high authority, including Brewster, Helmholtz and Michelson, have implied with varying degrees of definiteness that Newton made no subsequent improvement on this arrangement, and one can only assume that they had got their information from second-hand accounts without studying the original.

Brewster, for example, says[3]: "Had Newton received upon his prism a beam of light transmitted through a very narrow aperture [instead of a round hole] he would have anticipated Wollaston and Fraunhofer in their fine discovery of the lines of the prismatic spectrum. In 1802, Dr. Wollaston, by transmitting the light of the sky through an aperture one-twentieth of an inch in width, discovered six fixed dark lines in the spectrum, one in the red, one in the orange, one in the blue and one in the violet".

Wollaston, however, did not project the spectrum, but observed it subjectively by holding the prism to his eye.

Helmholtz[4] says that Newton did not use the methods which are necessary to obtain a complete separation of the various rays, and therefore he too did not see the Fraunhofer lines in the sunlight. Michelson[5] also implies that Newton did not use the slit and the focusing lens.

All these distinguished authors, however, are mistaken upon the point. Newton says[6]: "In the sun's light, let into my darkened chamber through a small round hole in my Window-shut, by which the image of the hole might be distinctly cast upon a sheet of white paper. . . ." On p. 49: "Yet instead of the circular hole *F* it is better to substitute a long parallelogram with its length parallel to the prism *A B C*. For if this hole be an inch or two long, and but a tenth or twentieth part of an inch broad or narrower: the Light of the image will be as simple as before or simpler, and the image will become much broader" [that is, the spectrum lines will be longer].

Another explanation is given by Kayser[7]. He says that a spectrum 25 cm. long, with a slit width of 1 mm. as used by Newton, should easily show the Fraunhofer lines, and he puts down Newton's failure to observe them to the fact, incidentally mentioned by Newton himself, that his prisms were of bad quality glass. A prism said, apparently on good grounds, to be one of his still survives in the British Museum, Department of British and Medieval Antiquities*, and it would be of interest to try it, but it is not accessible at present.

In any event, we cannot fully explain the difficulty in this way. Newton describes how he made up a hollow prism with flat polished surfaces (mirror glass) and filled it sometimes with water, sometimes with an aqueous solution of "Saccharum saturnii" (lead acetate) to increase the refraction, or rather as we should say, the dispersion. I have personally been able to see the Fraunhofer lines without difficulty and at the first trial, using a water prism of 60° angle and ordinary size. The spectrum was projected upon a screen by a lens of about 10 ft. focus. All these explanations which have been given of why Newton failed to see them, fall to the ground, because without using means superior, or even equal to his, a modern observer can readily see them.

In trying to understand how this happened, we must remember that the advantage of knowing what to look for is not easily over-estimated. Seeing that the phenomenon itself observed in this way is not very spectacular, the explanation seems adequate. It is not intended to depreciate Newton's great experimental skill, which, if I may venture an opinion, was equal to that of any man of whom we have knowledge. It is perhaps conceivable, after all, that he did see the lines, but that not having any reason to suspect the great importance of the matter, did not feel moved to probe it further, and passed it over in his written accounts.

The Telescope and the Spectroscope without Lenses

The view sometimes expressed that Newton failed to see the dark lines of the spectrum because he did not use a lens to form an image of his aperture is erroneous, because, as we have seen, he *did* use a lens. Nevertheless, the interesting question is raised of how good an image can be obtained without a lens. We need not introduce the question of prismatic dispersion at this stage. Everyone knows that you can get an image with a pinhole, but (it is usually supposed) not a very good one. My father discussed the question of how good an image could in fact be got. We are between Scylla and Charybdis in this matter. If we make the pinhole too large, we may in imagination divide it up into several apertures in different positions. Each of these gives an image in a different position, and the superposition of these produces confusion. If we make the pinhole too small, then the image of any one point on the object is widened by diffraction, and overlaps the images of other points, so that again we have confusion. Evidently there must be an optimum size for the pinhole. What is that size ?

In order to see this, it is a good plan to go back to the consideration of a lens, focusing a small source on a screen. What the lens does is to make the optical length from the source to the image the same for every path. The geometrical distance is no longer for a marginal ray than for a central ray, for the former path is bent and the latter straight, but the retardation of the light by glass makes up for this, and when the lens is in position, the effective distance (optical length) is the same for both, and the light arrives at the focus in the same phase from every part of the aperture. That is the essential function of a focusing lens, and it is only in so far as it does this that the lens is effective.

Now clearly if the aperture is small enough, the light *will* arrive in the same phase at every part of the aperture even without a lens. The question is, How big can we make it without introducing an important difference of phase ?

"Important" is, of course, a vague phrase. There can be no doubt that complete opposition of phase would be important, and certainly we shall harm the

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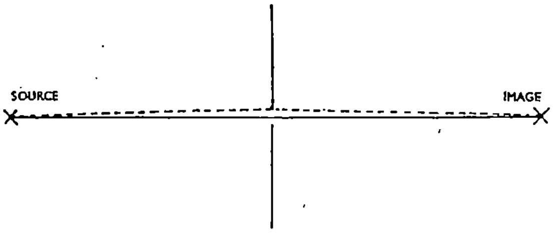
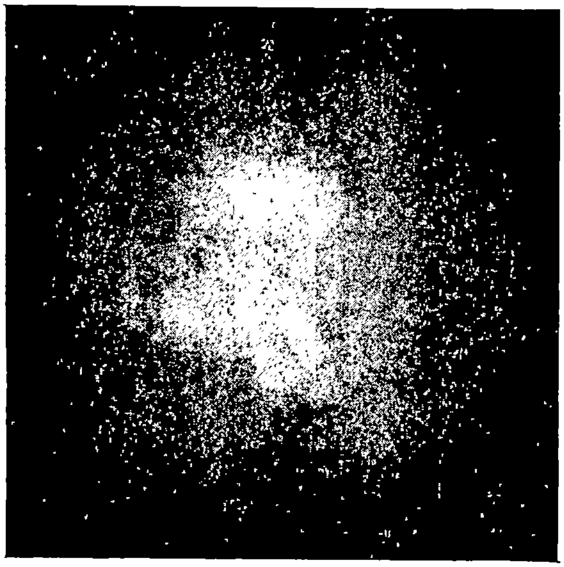
* See Rev. H. T. Inman, "Sir Isaac Newton and one of his Prisms". Privately printed (Oxford, 1927). I have not been able to consult this book and should be grateful to anyone who could give me the opportunity. It does not seem to be in any of the chief libraries. See also *British Museum Quarterly*, 2, 53 (1927–28).



definition if we introduce so large a difference of phase as this. On the other hand, we must not be too particular for the reasons already explained. We must allow a fraction, but only a fraction, of a period, and the fraction $\frac{1}{4}$ complies with this, and is justified by a closer consideration of the subject than can be attempted here.

If we want good resolving power, we must have large aperture, for the definition depends wholly on the aperture. The admissible size of aperture is determined by the consideration that the marginal ray is not to differ in phase from the central ray by more than a quarter of a period. This consideration alone does not fix the size of aperture, for supposing that we have set up the apparatus and find that the difference of phase is more than the specified amount of a quarter period, we can diminish it either by reducing the aperture, or alternatively by going farther off. If we go infinitely far away, no aperture of finite size is too great, so that in principle we could make as large a telescope as we like without an objective lens. However, if we attempt more than a very modest aperture, we shall find the necessary distance impracticable, for it increases as the square of the linear aperture. In my case, the distance available if the light was admitted at one end of the room was 19·6 metres ; taking λ as 5×10^{-5} cm. the admissible aperture $\sqrt{2 f \lambda}$ is 0·44 cm.

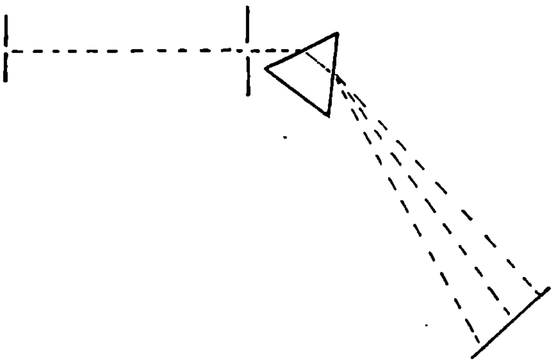
An iris diaphragm was placed in the window shutter, and could be adjusted to this aperture. The sun's light was reflected into the aperture and the image found of it was received on a sheet of paper 19·6 metres distant. When there were spots on the sun, they could usually be well seen on the paper. It is true that naked-eye sunspots do occur, though rarely. But ordinary small spots invisible to direct scrutiny, either with or without a dark glass, can readily be seen with the pinhole camera described. With the camera no dark glass is required*.



PINHOLE PHOTOGRAPH OF THE SUN SHOWING A SUNSPOT.

It may be objected that the 0·44 cm. as calculated is not much more than the aperture of the eye. This is no doubt true when the eye is dark adapted, and the iris fully open. But in these circumstances the eye by no means gives as good definition as the aperture would admit of. For the detection of sunspots at least, the pinhole camera is far superior to the unassisted eye. By going fairly close to the image, we can easily see it under a visual angle of, say, 20° or 30°, whereas the sun viewed directly subtends only $\frac{1}{2}°$, so that the magnifying power may be 40–60 diameters ; but, owing to the small aperture, this arrangement must not be expected to show the detail usually associated with that magnification. Magnification is, of course, no real criterion of what a telescope can do, which depends on resolving power. So much for the telescope without lenses.

Now for the spectroscope without lenses. In this case, the prism is put about half-way between the slit and the screen or photographic plate, and since both these distances had to be accommodated within the room† they were necessarily shorter than before. A single flint glass prism of 60° angle was used, and it was necessary to restrict its horizontal aperture to get a definite image of a spectrum line. On the other hand, there is no point in restricting the vertical aperture. The breadth of the horizontal aperture is determined on the same principle as the diameter of the simple image-giving hole which we have already considered. The distance of slit to prism was 8·55 m., and from prism to plate 9·10 m. If the allowable phase discrepancy is $\frac{\lambda}{4}$, taking λ as $5{\cdot}78 \times 10^{-5}$ cm. (yellow lines of mercury), we get for the admissible horizontal aperture 0·226 cm. The prism was put in and the aperture adjusted to give the best separation of the two yellow lines from a mercury vapour lamp. 0·21 cm. was too narrow, 0·27 cm. was too broad. 0·23 was judged best. Thus the expected result is closely confirmed.



The resolving power of a prismatic instrument is governed, according to the principles given by my

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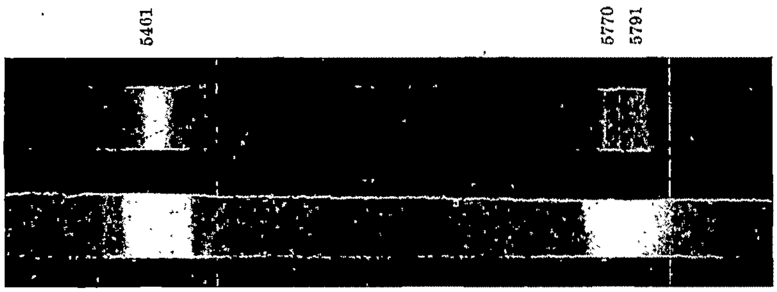
* Even a pinhole camera of half this length, with the aperture appropriately reduced, will show the spots fairly well, and allows the whole of the sun's disk to be photographed on a quarter-plate.

† I did not introduce the complication of using a plane mirror to increase the distance.



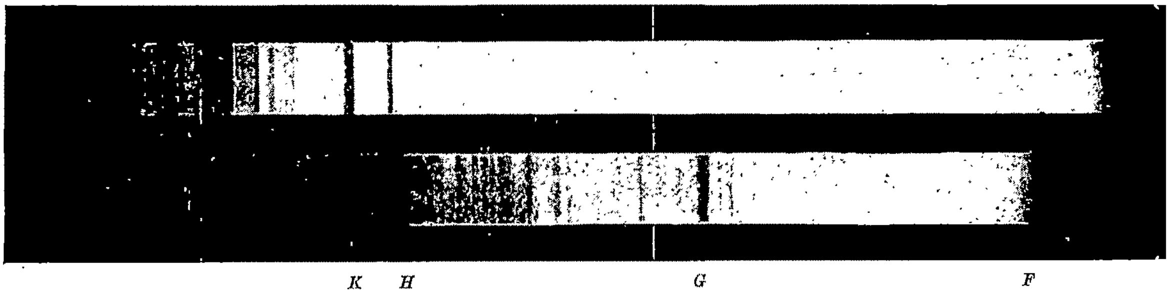
MERCURY SPECTRUM PHOTOGRAPHED WITHOUT A LENS. SUBORDINATE MAXIMA ARE SHOWN IN THE LOWER SPECTROGRAM, WHICH RECEIVED A LONGER EXPOSURE.

father[8], by the effective thickness of the base of the prism, which is supposed to be utilized up to the refracting edge. If f is this thickness, the resolving power $\lambda/d\lambda$ is given by:

$$\frac{\lambda}{d\lambda} = f\frac{d\mu}{d\lambda},$$

where μ is the refractive index. The value of $d\mu/d\lambda$ may be taken as about 1,000 cm.$^{-1}$. In one case with horizontal aperture 0·23 cm., it is about 0·4 cm., which gives $\lambda/d\lambda = 400$ as the theoretical resolving power, while for the mercury yellows $\lambda/d\lambda = 275$. The resolving power should therefore be very adequate to separate them, as experiments confirm.

To get much greater resolving power with a single prism and without a lens would require almost unmanageable distances. Thus it can be calculated that to resolve the D lines would require that the distances from slit to prism and from prism to screen should each be about 56 m. If three prisms had been used instead of one, then the D lines could have been resolved without greater distances than these used in my experiments.



SOLAR SPECTRUM, SHOWING FRAUNHOFER LINES, OBTAINED WITHOUT LENSES. THE UPPER SPECTRUM WAS GIVEN A LONGER EXPOSURE TO BRING OUT THE ULTRA-VIOLET.

In ordinary spectrograms the subordinate maxima bordering on either side the principal maximum of each line are very inconspicuous. In the present case they are much more obvious, owing to the small breadth of the aperture in comparison with the length of the beam. A longer photographic exposure is, however, desirable to bring them out clearly. The subordinate maxima are most conspicuous round the green mercury line, which is brighter than the yellow; moreover, the patterns due to the latter partially overlap. This photograph will make it clear to the eye why linear dispersion is not by itself a measure of resolving power. If we reduce the second aperture the diffraction pattern dilates and the resolving power is diminished, while the dispersion is, of course, unaffected.

The above tests made on the emission spectrum of mercury would lead us to expec
that the Fraunhofer lines coul
be observed with this instrument
In fact, they can readily b
photographed as far as the C lin
at 6563 in the red. The line
are, however, somewhat faint an
diffuse owing to the low resolvin
power not being very adequat
in the visual spectrum. They ar
not easily *seen* on the whit
screen, owing partly to this bu
more to the inadequate brightness, with the light from th
original rather short slit greatl
spread out both vertically and horizontally. Th
lines can be seen better if the distances from th
prism are reduced, say, to about 200 cm. each, an
the prism aperture readjusted to be somewha
narrower. We can then easily see the green line
(magnesium triplet) at 5178, and also F at wave
length 4861 in the blue-green. But the most strikin
demonstration experiment is to receive the extrem
violet on a fluorescent screen as used for X-ray
when the calcium lines H and K at wave-length
3968 and 3934 are very conspicuous, and could n
possibly escape notice. These lines are broader tha
the more visual lines, and at this part of the spectru
the specific dispersion of the glass, and consequentl
the resolving power of the instrument, are muc
greater. The instrument is, of course, astigmati
and the aspect of the spectrum, apart from i
brightness, is in no way altered if a small round ho
is substituted for the first slit.

The photographs of the Fraunhofer spectru
reproduced were on an ordinary (not colo
sensitive) plate. The ultra-violet part is sho
separately because it is best brought out by a long
exposure, which fogs out the visual spectrum. T
distance from the first aperture to the prism was 8
cm. as before, but the distance from the prism to t
plate was reduced to 152 cm. to get the desired ran
of spectrum on to the plate. The second apertu
was reduced to suit this diminished distance, but
will be seen, the resolving power remains adequate.

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[1] Rosse, William Parsons, 3rd Earl of, "Scientific Papers" (Lond 1926).

[2] Richardson, Alexander, "Evolution of the Parsons Steam Turbi (London, 1911).

[3] Brewster, Sir David, "Life of Newton" (1855), 117.

[4] Helmholtz, H. von, *Pogg Ann.*, 87, 45–56 (1852).

[5] Michelson, A. A., NATURE, 88, 377 (1912).

[6] Newton, Sir Isaac, "Opticks" (London, 1st ed., 1704), 47.

[7] Kayser, H., "Handbuch der Spectroscopie" (Leipzig, 1900), 1,

[8] Rayleigh, John William Strutt, 3rd Baron, "Scientific Pap (1879), 1, 415 and 430.

ROBERT KOCH

FOUNDER OF MODERN BACTERIOLOGY

A HUNDRED years ago, on December 11, 1843, Robert Koch was born. To celebrate his sixtieth birthday, his pupils, among whom were Ehrlich, Gaffky, Loeffler, Pfeiffer, Flügge, Gaertner and Wassermann, arranged a *Festschrift* in his honour and boldly dedicated it to him as the founder of modern bacteriology. A brief review of Koch's life and work will help us to judge whether he is entitled to this distinction and to estimate the significance of his work in the subsequent evolution of the subject.

Without doubt the early period of Koch's career is unsurpassed in dramatic interest, for as an unknown young practitioner in Wollstein, a little out-of-the-way town in Prussia, he carried on his researches, unaided and with the simplest equipment, to such purpose that in 1876–78 he had published three papers, two of which are acknowledged to be classics. He showed for the first time that anthrax is an infective disease caused by a specific bacillus with well-defined characters, and that it is reproducible at will by injecting pure cultures into susceptible animals. There is little wonder that Cohn, who was then professor of botany in Breslau, and Cohnheim, the eminent pathologist, both of them keenly interested in the fundamental but apparently insoluble problems presented by micro-organisms and their relationship to disease, were deeply impressed and were generous in helping Koch to devote his brilliant gifts to the service of humanity. Koch's researches on anthrax were published in 1876 in Cohn's journal, *Beiträge zur Biologie der Pflanzen.* A master of technique, he published a paper in 1877 on his methods. His studies on the etiology of wound infections appeared in 1878; he showed that, when bacteria in putrid fluids are passaged serially through mice or rabbits, the pathogenic varieties can be obtained post-mortem in pure culture and that the lesions are characteristic of the associated bacteria. Koch's interest in the subject doubtless arose from his experiences as an army doctor in the Franco-Prussian War (1870–71). He gave experimental support in this paper to Lister's antiseptic methods, but was unable from lack of clinical material to carry his researches further. The answer was soon supplied (1880–83) in the remarkable contributions of Alexander Ogston, later professor of surgery in the University of Aberdeen, who clearly defined the role of the micrococci in inflammation, and distinguished between Staphylococcus, as he named it, and Streptococcus (Billroth).

A wider field was opened to Koch when, in 1880, he was attached to the Imperial Department of Health in Berlin, where he worked on methods of sterilization and of testing disinfectants. He had quickly realized that, until a simple method of isolating bacteria in pure culture was evolved, progress would be seriously hampered. Methods such as Lister's dilution procedure were too much influenced by chance, and Koch therefore bent his energies towards devising a solid medium, finally utilizing gelatine, which had previously been employed for the culture of fungi, as a solidifying substance; later, agar proved to be more generally useful owing to its special properties. He demonstrated his methods of obtaining pure cultures at the International Congress of Medicine of 1881 in the Physiological Laboratory of King's College, London, with Lister and Pasteur in the audience.

During the early years in Berlin, Koch was fortunate in his chief assistants, Gaffky and Loeffler, who, like himself, were accurate and untiring workers. Within ten or twelve years they, with other pupils of Koch, discovered the causal agents of many important infectious diseases of man.

Koch's discovery in 1882 of the tubercle bacillus, his proof by animal experimentation with pure cultures that it is the cause of tuberculous diseases, and his employment in 1890 of tuberculin as a diagnostic and therapeutic agent, brought him world-wide fame, although the premature publication of his work with tuberculin proved, for a time at least, to have unfortunate results. Again, in 1900 he raised the question of the non-identity of the human and bovine types of the tubercle bacillus, and seemed to be unduly rash in proclaiming his belief that the pathogenic role of the bovine bacillus in man is negligible. Nevertheless, the provocative statement of his views led to an enormous amount of work on the subject in many countries, and perhaps chiefly in Great Britain. At the present time, Koch's old tuberculin has proved to be a valuable reagent and is still extensively used in both medical and veterinary practice. Work on the preparation of a highly purified and stable product based on biochemical analysis continues. The characters of the human and bovine types have now been satisfactorily determined, and it is agreed that in some localities the bovine type can produce the pulmonary form of tuberculosis in a high proportion of cases. The problem of the pasteurization of milk for human consumption bristles with difficulties of a practical kind, but their solution is certain to follow adequate and widespread appreciation among the general public of the issues that are involved.

Koch, in spite of his interest in laboratory technique, took no narrow view of the implications of his work. On the contrary, he well understood that his methods were essential as tools, together with the observations of the hygienist and the epidemiologist, for revealing the obscure paths of infection in outbreaks of disease. Thus on November 28, 1902, in Berlin he gave an address which serves as a landmark in the history of epidemics of enteric fever. His thesis was that the patient or convalescent who continues to harbour the specific germ is the chief source of the infection. At his instigation specially organized laboratories were stationed in the typhoid-ridden localities of Germany, with results which led to a notable reduction in the incidence of the disease and which shed much light on the carrier state.

Koch pursued his researches in many lands. In the years between 1896, at the age of fifty-three, and 1906, he studied sleeping sickness and malaria in Africa, in addition to rinderpest, East Coast fever, and piroplasmosis in cattle: in 1883 he had discovered the cholera vibrio from his investigations in Egypt and India; he was the head of the German plague commission in India; he worked on malaria in Rome; and he advised on anti-malarial measures in New Guinea. This brief statement of the range of his activities shows that he was a microbiologist of wide experience.

Much progress has been made in the thirty years since Koch's death on May 27, 1910, and there have been new and productive lines of research. Thus the related science of immunology has advanced at many points; and the participation of chemists and physicists in the study of bacterial bionomics, in the widest sense of this term, has been a most welcome feature of recent work, and has illuminated many hitherto obscure problems in bacterial nutrition and bacterial metabolism in general. The fresh edifice has been solidly built upon the sound foundations that were laid by Robert Koch nearly seventy years ago. He was truly a master-builder in the domain of science, and it is a sinister and indeed a terrifying aspect of the character of the German people that, owing to ill-founded racial prejudice, their notorious anti-semitic Press should have stooped to disown him, on the ground not that he was a Jew—for this he was not—but that he was a *Judenknecht*, who chose for his intimates such members of the 'hated race' as Cohn, Cohnheim, Weigert and Paul Ehrlich. Detraction of this kind cannot disturb the estimates that have been formed of Koch and his distinguished friends and supporters by the rest of the world, which owes and will ever continue to owe an immense debt of gratitude to these great pioneers of a new science.

G. F. PETRIE.

THE RECENT EARTHQUAKE IN TURKEY

By ERNEST TILLOTSON

EARLY on November 27, 1943 (local time), another very strong earthquake occurred in the region east of Ankara between central Anatolia and the Black Sea coast. The earthquake caused much damage in the towns and villages of Samsun, Osmanjik, Tokat, Herek, Ordu, Amasia and Kastamuni. 1,439 buildings have been reported wrecked and 1,570 damaged, and damage was done to roads, railways and telegraph lines. On November 30 the Ankara radio stated that the deaths caused by the earthquake numbered 2,919. Many thousands more were injured.

At Istanbul Observatory the pulses were so violent that the seismograph was unhinged. At Kew Observatory on November 26, a very strong earthquake was recorded by the north–south, east–west and vertical component seismographs. On the vertical component the primary wave registered impulsively at 22h. 26m. 08s. U.T. and a further *iP* pulse registered on all three components at 22h. 26m. 15s. U.T. The maximum ground amplitudes at Kew were: on the vertical component, 960 μ at 22h. 35m. 47s. U.T. with a period 25; on the north–south component, 1040 μ at 22h. 42m. 35s. U.T. with a period 24; and on the east–west component, 1120 μ at 22h. 46m. 13s. U.T. with a period 25. From a preliminary interpretation of the seismogram the epicentral distance from Kew is estimated to have been 2,970 km., which would be consistent with an epicentre in Anatolia.

From the above evidence it would appear that the epicentre was very close to lat. 41·1° N., long. 35° E., which is north of Çorum and half way between Amasya and Kastamanu, and west of the Black Sea port of Samsun in Anatolia, Turkey. The time of origin of the shock would be near 22h. 20·5m. U.T. on November 26, or 0h. 40·5m. local time on November 27. It appears that the earthquake may have had an epicentral region occasioned by extensive faulting rather than a point epicentre; but if, for purposes of calculation, it is desired to envisage a point focus, this would seem to have been rather deeper than normal.

Strong earthquakes have occurred in this and adjoining regions as follow: 330 B.C., Niksar; A.D. 343, Niksar; 366, Niksar; 499, Niksar and Amasya; 1509, Çorum; 1754, Sivas; 1826, Erbaa; 1827, Tokat; 1875, Niksar, Bereketli; 1877, Mesudiye, Çavdar, Lâdik, Erbaa, Efte; 1890, Niksar; 1895, Çavdar; 1897, Efte; 1899, Erbaa; 1904, Ş. Karahisar; 1906, Reşadiye; 1908, Alucra; 1909, Ş. Karahisar; 1911, Mesudiye; 1913, Reşadiye, Niksar, Almus; 1914, Erbaa, Lâdik; 1919, Almus; 1937, Alucra; and 1938, Kirşehir. But by far the greatest occurred on December 27, 1939, at Erzincan (NATURE, January 6, 1940, p. 13). This latest earthquake mentioned was the forerunner of numerous other smaller shocks which happened throughout the remainder of December 1939 and January 1940, and then major ones on April 14, 1940, July 30, 1940, September 12, 1941, November 12, 1941, a swarm throughout November and December 1941, December 21, 1942, and on June 20, 1943, at Adapazar when 1,304 people lost their lives. Most of these have been mentioned in the "News and Views" columns of NATURE, and there have been scores of smaller shocks at intermediate times from the same epicentra region east and north-east of Ankara.

The present earthquake, though violent, appear to be one of the series which began on December 27 1939. It exemplifies a well-established observationa fact that earthquakes tend to recur in a region onc affected. Whether this is due to the persistence o regional earth-forces and lines of crustal weakness whether it is due to elastic afterworking in the sub crustal layers of the earth, or to the readjustmen of crustal blocks following a large-scale block-faulting movement, is not yet established. One or more o these may be important, and in particular cases othe factors may be fundamental, but whatever the cause it is instructive in view of acknowledged recurrenc to examine past examples.

On April 19, 1938, at about 13 hr., an earthquak occurred in the region of Kirşehir, a village som 140 km. south-east of Ankara. The zone most affecte was between the Delice Irmak in the north-east, th Kiliç Özü in the north-west, the route from Kirşehi to Ankara in the south-west and the depression forme by the Sife Gölü in the south-east*. In the surroundin villages and towns the following percentages o houses were destroyed: Aci, 85 per cent; Efendiköy 82 per cent; Koçbeyli, 82 per cent; Ceritobasi, 81 pe cent, and in other villages smaller proportions. Th epicentral region enclosed within isoseismal 10 wa elongated from north-west to south-east. The principal permanent movement occurred horizontall along a fault, the southerly portion being displace to the north-west relatively to the northerly portio for throws ranging from 30 to 100 cm. The movement along this fault of Akpinar is aligned wit orogenic movement in the region since Mesozoi times, but whether the movement was due to dyin or growing earth-forces is not known.

The earthquake of December 27, 1939, at 2 h (Erzincan) which caused the deaths of some 35,00 people had an epicentral zone stretching fro Erzincan to Amasya and from Carsamha to Artova an area roughly rectangular in shape, 360 km. b 120 km.†. The towns and villages most affecte

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[*] Ed. Paréjas-Hamit N. Pamir, "Le Tremblement de terre d 19 Avril 1938 en Anatolie central". Publications de l'Institut Géologie de l'Université d'Istanbul, No. 5, Nouvelle Série, Février 194

[†] Ed. Paréjas, I. H. Akyol, E. Altinli. "Le tremblement de ter d'Erzincan du 27 décembre 1939". Publications de l'Institut Géologie de l'Université d'Istanbul, No. 10, Nouvelle Série, Avril 194

were Tokat, Samsun, Ordu, Giresun, Sivas and Gumushare. In the block-faulting associated with this earthquake, four east–west lines were prominent: (1) the line of the upper Yeşil Irmak; (2) the line of the Kelkit–Deliçav; (3) the line of the Yavlas and middle Yeşil Irmak; (4) the line parallel to the Black Sea about 15 km. distant from the shore.

These lines were in part old orogenic lines, and were called into play again to relieve accumulating stress. Two distinct earthquake movements were observed during this shock. The first was horizontal and the latter, separated from the former by a short interval of time, had a distinct vertical component. With these, but particularly the latter, strong low-pitched rumbling sounds were associated.

OBITUARIES

Prof. H. L. Lebesgue, For.Mem.R.S.

Henri Léon Lebesgue, professor in the Collège de France, a foreign member of the Royal Society and an honorary member of the London Mathematical Society, was born at Beauvais, Oise, on June 28, 1875; news of his death during 1941 recently reached Great Britain.

Lebesgue was one of the greatest mathematicians of recent times, but more of a specialist than most great mathematicians. His work has not the variety and versatility of Poincaré's or Hilbert's; he did not, as they did, enrich almost every branch of mathematics with his contributions. He was rather a man with one outstanding claim to fame. He had other things to his credit; for example, he made one important contribution (the *Pflastersatz* or 'pavement theorem') to topology; but that, and all his secondary work, of which there is not much, is overshadowed by his work on integration. There, he was first: the 'Lebesgue integral' is one of the supreme achievements of modern analysis.

It is no exaggeration to say that Lebesgue remade the integral calculus. The theory of functions of a real variable, of which the differential and integral calculus are parts, has been rewritten since 1900. The revolution had been initiated by Borel, whose famous monograph "Leçons sur la théorie des fonctions" was avowedly the starting point of Lebesgue's researches; but it was Lebesgue himself who took the decisive steps. The older theories of integration, in spite of all that Riemann, Darboux and others had done, were radically defective at several vital points, and in particular in their relations to differentiation. It was not true that differentiation and integration were 'usually' inverse operations, that integration and differentiation, or differentiation and integration, usually restored the original function. Indeed the whole theory was æsthetically unsatisfying; it tended to be cumbrous, long-winded and full of untidy exceptions; and the conservative mathematicians who detested it had a certain amount of excuse for their distaste.

All this is changed; the theory is now one of the most beautiful in mathematics. It unfolds itself in a series of terse and comprehensive theorems, with all the smoothness and elegance of the best 'classical' analysis. In particular, differentiation and integration dovetail harmoniously together. It is a readily intelligible, almost a 'popular' subject, and for this, by the unanimous testimony of every worker in these fields, it is to Lebesgue first that honour is due.

Lebesgue was a fine writer, with an admirably vigorous and lucid style. His two great memoirs, "Intégrale, longueur, aire" (1902) and "Sur les intégrales singulières" (1910), and his two books, "Leçons sur l'intégration" (1904 and 1928) and "Leçons sur les séries trigonométriques" (1906), rank among the classics of mathematical literature. It is sad that the second book should never have been re-edited, since the subject gives perhaps the finest illustration of the inevitability and vitality of Lebesgue's ideas. G. H. Hardy.

Dr. George Washington Carver

Dr. George Washington Carver, the distinguished Negro scientific worker who died at Tuskegee Institute, Alabama, on January 5, 1943, was born of slave parents at Diamond Grove, Missouri, in 1864. He was educated at Minneapolis High School and later at Simpson College, Indianola, Iowa. Graduating in science at Iowa State College in 1894, he proceeded to the M.Sc. two years later. In 1896 he was invited by the late Dr. Booker T. Washington to take charge of the Department of Agriculture at Tuskegee. He discovered on arrival that his duties, apart from administration and normal academic lectures, entailed the reshaping of the entire economy of the district. In fact, he had to conduct mobile classes in the field in order to persuade a despairing and ignorant community that its only salvation lay in adopting a new agrarian economy. The soil, he found, was arid, eroded, unproductive, and the system of farming outmoded. Every farmer in the region was cultivating cotton as a staple crop. Carver's open-air lessons included the cultivation of crops, soil conservation, fertilization, insect control, plant pathology, and the canning and drying of fruits and vegetables.

Carver recognized the necessity for introducing the peanut, *Arachis hypogaea*, and the sweet potato, *Solanum tuberosum dulce*, because soil and climatic conditions were favourable, and the crops were already being grown sporadically for local consumption by large sections of the community. He realized early that the replacement of cotton by peanuts and sweet potatoes was not a complete solution, and that newer and more extensive uses for them had to be found. A long series of chemical experiments culminated in the development of face powder, pigments, paints, stains and ceramic materials from Alabama clays; milk, buttermilk, cream, cheese, condiments, coffee, paper, plastics, stains, insulating boards and more than three hundred by-products from peanuts; starch, tapioca, syrup, coconut substitute, breakfast food, stains, artificial rubber, vinegar and paste from sweet potatoes; paving blocks, insulating boards, rugs, and cordage from cotton. Peanut milk is now being extensively used in infant clinics in areas of tropical Africa where the tsetse fly is endemic.

Carver's scientific achievements have dwarfed his artistic work, but those who have seen his "Three Peaches" at the Luxembourg, or his "Yucca" at Tuskegee, are unanimous in their regret that he had not devoted more time to this department of life. As a man of science, he tenaciously refused to make profits from his inventions and discoveries, and never once took out a patent. It was characteristic of him to decline Thomas Edison's invitation to join his staff, preferring to work in obscurity among the simple folks he had come to know and love so much.

During his life-time, more than sixty books, periodicals and films were devoted to his life and work, and he had delivered addresses at most of the leading universities in the States. Carver was awarded the Spingarn Medal in 1923 for distinguished services to science, and in 1939 he was given the Roosevelt Medal for outstanding contributions to agriculture. The unique position he won for himself in American scientific and social life was marked by the Variety Clubs' award of 1941. This award was made by a national nominating committee of thirty-four eminent editors, publishers, authors and radio commentators, and consisted of a silver plaque commemorating his selection, and an honorarium of one thousand dollars in cash "in token of his sublime service in restoring a multitude of helpless people to happy and productive life through the instrumentality of his brilliant laboratory researches".

Thus grew to maturity and fame, a lad who was once traded for a horse! R. E. G. Armattoe.

We regret to announce the following deaths:

Dr. H. D. S. Honigmann, formerly director of the Breslau Zoological Gardens, and recently scientific adviser to the Dudley Zoo, on November 17, aged fifty-one.

Mr. Geoffrey H. Livesey, a former president of the Royal College of Veterinary Surgeons, and former editor of the *Veterinary Record*, on November 29.

Prof. James Young, O.B.E., formerly professor of science at the Royal Military Academy, Woolwich, on December 2, aged eighty-one.

NEWS and VIEWS

Physical Society: Duddell Medal Award

The twentieth Duddell Medal has been awarded by the Council of the Physical Society to Mr. John Guild, of the Light Department of the National Physical Laboratory, in recognition of his design of a number of optical and physical instruments of outstanding merit. Mr. Guild, who was born on November 16, 1889, was educated at Allan Glen's School, Glasgow, and the Imperial College, London. His instruments are noteworthy for their sound mechanical, optical and physical design and for the scrupulous avoidance of all elaborations that would not contribute to their final precision and accuracy; they incorporate many features that were novel at the time the instruments were developed. The best-known and most important of them are, perhaps, his spectrophotometer (1924), trichromatic colorimeter (1925) and absolute radiometer (1937); but it is difficult to select any one instrument as being more elegant in design than the others, which include a spherometer of precision (1917), a very accurate angle comparator for the goniometry of prisms (1923), a flicker photometer (1923), a vector colorimeter (1925), an improved goniometric spectrometer (in collaboration with the late Mr. George Watts, 1926), a compensated thermopile (1931) and a new instrument for evaluating the surface finish of metals (1940). The Medal will be presented to Mr. Guild at a meeting of the Physical Society at the Imperial College on December 17.

Chair of Geology, Durham: Prof. L. R. Wager

Dr. L. R. Wager, whose appointment to the chair of geology at Durham has been announced, takes with him a distinguished record as a petrologist, an explorer and a mountaineer. Since 1929 he has been lecturer in petrology in the University of Reading, where the efficiency of that section of the Geological Department owes much to his vigorous enthusiasm. While still at Cambridge he had given a foretaste of his ability as a research student in a series of papers on the Whin Sill and part of Connemara. In 1930 he was granted leave to take part in the British Arctic Air Route Expedition to East Greenland, where he made preliminary studies of a peculiarly interesting suite of igneous rocks. In 1933 he was released again to act as one of the climbing party on that year's expedition to Mount Everest. He took part in the first assault, reaching as great a height as has yet been attained. Incidentally, he made many valuable contributions to our knowledge of the stratigraphy and physiography of that part of the Himalaya. On his return to Reading he began to organize a scientific expedition to continue his work in East Greenland, and took a small party which spent twelve months there. The published results of the petrological and mineralogical studies thus made, although as yet incomplete, are works of outstanding scientific importance. Shortly after the outbreak of war he joined the Royal Air Force in a specialist capacity, and held the rank of squadron leader at the time of his appointment to Durham.

Suggested New School of Aeronautical Science

Replying to a question raised in the House of Commons on December 1, the Minister of Aircraft Production, Sir Stafford Cripps, announced that the Aeronautical Research Committee had recommended the creation of a new school of aeronautical science, co-ordinated with existing training facilities, to bridge what it considers to be a gap in the present system. This report is approved in principle by the Government, and an interdepartmental committee has been appointed to prepare detailed proposals for its establishment. The Committee is under the chairmanship of Sir Roy Fedden, sometime designer and chief engineer of the engine section of the Bristol Aeroplane Co. This Company was one of the first in the aeronautical world to initiate an apprentice training school in its works under Sir Roy's guidance, and in addition he has just returned from a tour of the United States, where he has studied the systems of aeronautical instruction in use there.

Although the terms of the report were not announced, it presumably follows the scheme envisaged by Sir Bennett Melvill Jones, the chairman of the Aeronautical Research Committee, in his remarks at a recent discussion upon aeronautical education before the Royal Aeronautical Society. The schoo will be postgraduate and will be additional to the facilities of a similar standard at present available at universities. It will deal with advanced study and experimental work of a technical nature, leaving the more scientific and research aspect to the university schools. It is also hoped to include certain aspect of flying, incidental to the teaching. It is hoped tha such a training will appeal to the university graduat who desires to take up the more applied side of the profession, the works apprentice who has attained a sufficiently high standard in theoretical study, and possibly senior men from the industry and the Forces who desire refresher courses.

A Programme for the Royal Society of Arts

Dr. E. F. Armstrong's inaugural address to the Royal Society of Arts on November 3 entitled "The Long Road of Progress" reviewed briefly the general trend of the Society's activities since its foundation in 1754, commenting on the number of the older societies which regard the Royal Society of Arts as a foster parent. While it is no longer the tradition that the first popular account of any discovery or invention is given to the Society, that tradition is always prominently before the Society in arranging its programme. Discussing the future, Dr. Armstrong urged that the Society should help to form public opinion on housing, on nutrition, and other subjects, through the medium of its members and their friends in a way that the Press, which to-day is largely political and seldom practical, can never do. In addition to lectures, however, it could pursue such projects as raising the artistic standard of the nation, as through its institution of the award Royal Designer for Industry, and its recommendations as to the best training for students intending to design for industry and in art schools in general, and the best methods of selection of young persons for such work.

After a reference to education and to the value of the examinations of the Royal Society of Arts, Dr. Armstrong touched on the question of research and the necessity of having the right kind of men to carry it out efficiently, and the importance of providing the proper facilities. Factories, he emphasized, are worth as much as the ability that directs them and no more, and even in research the head of the department must understand the art of managing men and be able to get along with them and to think as they think. A research department should be changing all the time, so as to bring in young men with ideas. Finally, popular interest in science must not only be maintained, but even increased, if we are to hold our own in the years to come. Whether carried on with Government support or in endowed institutions of learning, the full development of our scientific potentialities depends upon the appreciation of the public. This means continually providing the public with impersonal news regarding scientific progress in all lines of interest to them, from both the material and the philosophical points of view. Moreover, the biggest fight in the post-war world is likely to be for individuality. Science needs tolerance, freedom from restraint and a recognition of the value of individuality, and because it has freed men's minds and helped to free man's soul by broadening the basis of religion, it is regarded by some as the great hope of mankind. We must learn the facts about the environment in which we live if we wish to adjust ourselves harmoniously with it.

Astronomical Work in the U.S.S.R.

Some information about astronomical activities in the U.S.S.R. has been received from Alexander Orlov, formerly director of the Odessa Observatory and now director of the Poltava Observatory, which was built in 1926 for the study of latitude variation and the movements of the earth's pole. When the Germans were approaching Poltava, the valuable equipment of the Observatory was removed to Irkutsk in Siberia, to save it from the destruction that had overtaken the Pulkovo Observatory, near Leningrad. When the Red Army liberated Poltava, M. Orlov returned there, passing through Kharkov *en route*. In Kharkov all the main buildings and cultural institutions were in ruins; of the staff of the Kharkov Observatory, who had not succeeded in escaping before the Germans arrived, some had been killed, some had died of hunger, some were missing and the few who survived were in a deplorable condition. In once flourishing districts of the Ukraine everything had been burnt or destroyed. The city of Poltava had been destroyed with deliberate thoroughness; it had been surrounded and nobody allowed to leave. The Poltava Observatory was damaged, but by chance had escaped destruction. The Ukrainian Government has decided to restore the Observatory as quickly as possible; funds for this purpose, and for a considerable extension of the work of the Observatory, are being assigned. During the past session of the Academy of Sciences of the U.S.S.R. it was decided to open another observatory for latitude-variation work at Komosomlsk, in the same latitude as Poltava. It was also planned to create a central observatory near Kiev, for fundamental observations, analogous to the Pulkovo Observatory.

Functions of the Special and General Libraries

Mr. G. Woledge, librarian of the Queen's University, Belfast, has directed attention, in a letter to the Editors, to a conflict of interests between the small special library and the large general library, which appears to be suggested by the discussions at the ASLIB Conference last September on the international rehabilitation of special library services. Mr. E. J. Carter's paper on the "Rehabilitation Problem and the Service and Technique of Special Libraries and Information Bureaux" and Mr. F. C. Francis's paper on "The British Museum as a Special Library" indicate, indeed, though without explicitly stating so, that the two types are complementary, not competitive, and quite apart from questions of co-operation involved in distribution and dispersion, it is clear both from Mr. McColvin's report on public library service and the more recent statement issued by the Council of the Library Association that the position of special libraries and reference libraries in the general lending library service of Great Britain is receiving attention.

Mr. Woledge acknowledges the immense contribution to research which has been made by the system of inter-library lending through the National Central Library; but points out that there are as yet no accepted principles by which we can determine the complicated question of the desirable minimum of book-resources for the country's research work. Leaving aside altogether the question of the duplication of the most important books—those of which many copies may be in use at the same time in different places and those which are indispensable in any scientific man's library—it is not enough to have only one copy of each book which may be wanted or only one collection for each subject. While the special library has a better chance of completing its collection of the more elusive kinds of literature and can be organized from one exclusive point of view with a specialist and expert staff, the staff of a general library also has its rather different but characteristic expert knowledge, and in so far as it is prevented from specializing is saved from onesidedness. Even from the point of view of research we need general libraries, highly specialized libraries and intermediate collections; libraries from which books can be borrowed and those from which they cannot. The most desirable lines for their development can only be decided after careful examination, subject by subject, of the needs of those who use them. A general survey of Great Britain's needs would, as Mr. Woledge suggests, and has already been strongly recommended as an urgent need in the McColvin report, be of great value in helping to make the best use of available funds, and his warning that funds cannot be unlimited or expended extravagantly is timely. Mr. Woledge scarcely formulates the questions which must be answered before either large or small libraries can take the fullest part in a national system of providing books and information, but he shows that all engaged in library work should consider more closely their functions, not only in relation to special needs, but also to those of the nation as a whole and the contribution they are best equipped to make to national needs.

Radiolocation and Shipping Risks in Peace-time

The fifteenth report from the Select Committee on National Expenditure for the session 1942–43, dealing with the salvage of ships and cargoes, contains important references to developments in radiolocation which seem likely to reduce shipping casualties, and thus to decrease the amount of salvage work to be done in normal times. As a decision on the future use of the large quantity of radiolocation equipment owned by the Government is urgently required, evidence was heard from eminent scientific workers and from representatives of Trinity House on the possibility of using it to increase the safety of navigation after the War under conditions of low visibility. The Committee was assured that much of this equipment would be of value for such purposes, and accordingly it recommends that the Government should examine the question of the post-war use of radiolocation apparatus for safety at sea, together with the making of any international agreements required. The bulk of the report gives an interesting picture of the general salvage position in 1939 and during the War, which does not always reflect credit on the Admiralty. While the Committee resists the proposal to create a monopoly for British salvage enterprises in British territorial waters, unless the hopes of a general breakdown of monopolies and barriers to commercial activity are disappointed, it advances proposals for maintaining British salvage enterprises in so sound and efficient a state that underwriters will not be obliged to call on the services of foreign firms.

The Royal Irish Academy

The meeting of the Royal Irish Academy on November 8 was devoted to a celebration of Hamilton's discovery of quaternions. A well-attended meeting which included Mr. De Valera and other Ministers was addressed by the president, Dr. R. I. Best, who read messages from Prof. G. D. Birkhoff of Harvard and Prof. J. L. Synge of Ohio State University. An account of the Dublin mathematical school in the early nineteenth century with reference to the work not of Hamilton only but also of McCullagh, Lloyd, Jellett, Haughton, Salmon, etc., was given by Prof. A. J. McConnell. Prof. A. W. Conway read a paper on quaternions and matrices in which he showed that the use of quaternion methods makes for great simplification of the meson matrices. A paper by Prof. E. T. Whitaker on the sequence of ideas in the discovery of quaternions and a note on quaternions by Prof. G. D. Birkhoff were also read. A paper by Rev. J. R. Colthurst on the Inconsian calculus of Sir William Rowan Hamilton was read in title. A communication from Prof. F. D. Murnaghan of Johns Hopkins University, entitled "A Modern Presentation of Quaternions", owing to postal delays was received too late for the meeting, but will be included in the report of the proceedings which will be printed.

The Haffkine Institute, Bombay

The report for 1940–41 of the Haffkine Institute at Parel, Bombay, shows a record of widely useful work, of expansion of departments to meet the needs of the War and of increased production of sera, antitoxins and vaccines for the Forces. A new department for the manufacture on a large scale of antitoxins, toxoids and sera has been begun and the Institute has found that it can produce these at a cost one half to one sixth of that of the imported products. The Department of Chemotherapy is also new; it reports that sulphathiazole is effective for the treatment of bubonic plague. Sulphonamide products are being synthesized, their commercial production is being investigated and new compounds in this series are being sought. The production of Haffkine's antiplague vaccine and other work on plague occupy, perhaps naturally, a considerable part of this report. But interesting work is also being done in an endeavour to replace the standard malarial remedies, the supply of which has been reduced by the War. It is claimed that sulphathiazole and another sulphonamide prepared by the Institute have remarkable curative effects on monkey malaria without the relapses which follow the treatment of monkeys with atebrin and quinine.

Poliomyelitis in the United States

According to official information, the incidence of this disease in July reached epidemic proportions in several south-western States, and the figures for the country during the first six and a half months were the highest in twelve years. Figures for the week ending July 17 showed 297 cases in the United States as compared with 245 for the preceding week; 231 cases or 94 per cent were reported from three States, namely, Texas with 102, California with 90 and Oklahoma with 39. For the first twenty-eight weeks of 1943, 1,626 cases were listed for the entire country.

Islands and Peoples of the East Indies

War Background Studies of the Smithsonian Institution, No. 14, relates the story of the East Indies and their inhabitants. The account does not pretend to be other than superficial, but for the intelligent reader wishing to know something about an area that may at any time now come to figure largely in the war news, this book can be confidently recommended. It contains a great deal of information and is beautifully illustrated.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Future of Anthropology

In the discussion on the future of anthropology at the centenary meeting of the Royal Anthropological Institute, as reported in Nature of November 20, there seems to have been a serious misconception of the natural scope of physical anthropology. In my presidential address to Section H of the British Association in 1939, I discussed the subject at some length, and suggested that the future of this important science may be seriously jeopardized if it is not allowed to develop naturally along progressive lines.

Dr. Firth is quite correct in his statement that physical anthropology is a branch of biology, and it may be added that it should therefore be in the hands of trained biologists. It is no doubt due to the neglect of this fact that the subject seems to have undergone considerable stagnation in recent years. The view was expressed at the centenary meeting that physical anthropology is entirely a historical science. Indeed, the writer of the report in Nature goes so far as to suggest that as soon as physical anthropology is applied to practical problems it ceases to be physical anthropology !

This view can scarcely be too vehemently controverted. Physical anthropology is certainly a historical subject in so far as it studies the organic relation of the human species to lower animals, its evolutionary origin, its differentiation into races* and sub-races, and the relation of physique to the different conditions of life in the past. But it is equally certain that it also concerns itself with actualities by the comparative study of living races and their geographical distribution, and by the study of problems of growth and physique in relation to environment and of racial differences in physiological processes. The subject of comparative racial physiology (which is clearly a department of physical anthropology) has hitherto received little attention. Yet its importance must be obvious, and it is not too much to say that the future of physical anthropology will depend almost entirely on its due recognition.

Probably no adequate and complete survey has been made of any native population living under primitive conditions to ascertain from random samples what level of physical efficiency is possessed by its members, how far this is related to inborn racial differences, or to nutrition, climate and other environmental factors. It is important to know to what extent physical efficiency can be improved by higher standards of diet, hygiene and so forth, how human races vary in their adaptability to different environments and different conditions of life, whether there are racial differences in susceptibility to disease or dietetic deficiencies, in ability to resist physical stresses and strains, in relative rates of growth and maturation, in fertility and longevity, in their reaction to extremes of temperature and humidity, etc. We require data regarding the functional efficiency of different physiological systems (cardio-vascular, respiratory, nervous, excretory, digestive, etc.) in different races, and the physical anthropologist of the future must be acquainted with the various physiological and biochemical techniques by which this efficiency can be gauged.

It is scarcely necessary to say that problems of this kind must be answered as a preliminary basis for the social, educational and economic advancement of the more primitive and backward races of mankind, and are thus of considerable practical importance. At the same time, since the physical efficiency of different races must have repercussions on their social and cultural development, it is clear that in the future physical anthropology must keep in close contact with other branches of anthropology, so that the study of mankind remains a properly integrated subject.

If the science of physical anthropology is allowed to follow its natural development along the lines suggested, it will open up a progressive and active field of study which is likely to attract students who are both able and enthusiastic. If, on the other hand, it confines itself to the narrow laboratory study of crania and other parts of the skeleton (a study which is rapidly becoming sterile in spite of new statistical methods) it will soon cease to earn any respect from workers in other branches of anthropology.

Dr. G. M. Morant has pointed out that the three whole-time posts in physical anthropology in Great Britain before the War are now not actively occupied. I would suggest that this provides an excellent opportunity for the complete re-orientation of the subject along functional lines, and that efforts should be made to promote this natural development as soon as possible.

W. E. Le Gros Clark.

Department of Human Anatomy,
University Museum, Oxford.

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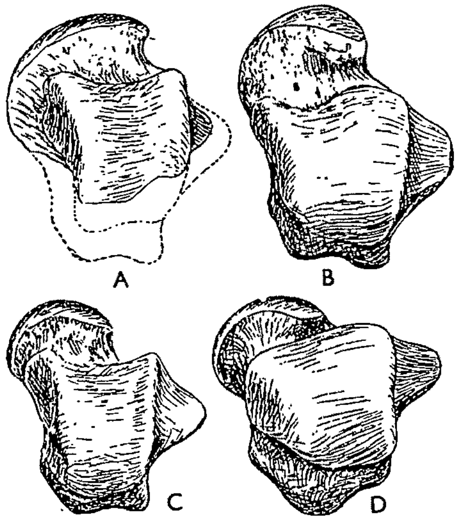
[*] The term "race" is used here in reference to the main ethnological groups of mankind, and without prejudice to its application otherwise.

An Ankle-Bone of the Ape-Man, *Paranthropus robustus*

Every addition to our knowledge of the structure of the ape-men of South Africa is likely to be welcomed even though the addition may appear to be a very small one. The Taungs ape, and those discovered at Sterkfontein and Kromdraai, have revealed a group of higher Primates which are very much nearer to man than any living anthropoids, or any of the fossil forms previously discovered. Though the brains are sub-human in size, they are much nearer in structure to that of man than are the brains of the gorilla and chimpanzee, and the dentition is practically human. All the fragments we have of the post-cranial skeleton are so nearly human that had they been found isolated most anatomists would probably have maintained that they were human.

We know the distal end of the femur of the Sterkfontein ape-man, and a perfect os capitatum (os magnum); and of the Kromdraai ape-man we have the distal end of a humerus, the proximal end of an ulna, a metacarpal and a number of phalangeal bones of the hand, and a few toe bones.

In the block of matrix in which the Kromdraai skull lay, there was seen a piece of very badly weathered bone. It looked very unpromising; but when cleaned out it proved to be the most important part of the right talus. The fragment consists of rather more than half the bone, and it shows the greater part of the proximal or upper side. The articular surfaces for the tibia and fibula are nearly



Right talus (astragulus) of (*A*) *Paranthropus robustus* Broom; (*B*) female bushman; (*C*) female chimpanzee; (*D*) a large gorilla. *A*, *B*, and *C* are ¾ nat. size; *D* is ½ nat. size.

perfect, and rather more than the upper half of the distal end is satisfactorily preserved.

In size, this talus agrees fairly well with that of a female Bushman; but in structure the bone differs considerably. The articular surface for the navicular is much broader and more horizontal than in the Bushman, and it extends a little farther inwards than in most human tali.

The articular surface for the tibia and fibula is narrower than in any human tali I can find, and a little differently shaped. A comparison with the proximal articular surface in the talus of the chimpanzee shows considerable resemblance, but the articulation for the navicular in the chimpanzee is very different.

There is very little resemblance between the talus of Paranthropus and that of the gorilla; the tibial articulation being very different.

There cannot, I think, be the slightest doubt that this talus is that of the type *Paranthropus robustus*. The head, jaw, humerus and ulna fragments, the bones of the hand, and this talus are all from one mass of bone breccia less than a cubic foot in size.

The talus is manifestly that of a Primate slightly larger than a chimpanzee. In general structure the bone resembles that of a man more than it does that of any of the living anthropoids, and the little evidence that it brings is in favour of Paranthropus having been bipedal, and of its having had a well-developed hallux.

Paranthropus, though a little less human in its milk molars than Australopithecus or Plesianthropus, is more human in its having a much larger brain.

Paranthropus, in having a brain of about 650 c.c. and a very lightly built body of probably not more than 80 lb. or 90 lb., and in being most probably bipedal, with delicate slender hands, must have been an animal much more like a human being than either the chimpanzee or gorilla. Like the other known Australopithecines, it was certainly not a forest-living Primate, but a being who lived among the rocks and on the plains and hills as the baboons do to-day.

It is hoped that before long a complete work will be issued on all that is known of the Taungs, the Sterkfontein and the Kromdraai ape-men.

R. BROOM.

Transvaal Museum,
Pretoria. Sept. 8.

Distribution of Colour-blind Men in Great Britain

DURING the past two years the colour vision c many thousands of recruits for the Royal Navy ha been tested by a modified form of the Ishihara an Stilling Tests. Thus for the first time it has becom possible to compare the proportions of colour-blin men in different regions of Great Britain on a larg scale. Significantly greater proportions have bee found to occur in the western than in the easter half of the country. The following table gives th percentages of defectives in nine major areas o Britain, each percentage being based on more tha 6,000 cases. Each percentage has also been adjuste for the lower level of intelligence which occurs i some testing centres than in other centres, since i has been found that men of very low intelligenc tend to do less well at the test.

Area	% Defective	Corrected for intelligenc
N.E. Scotland (Wick, Edinburgh, Galashiels, etc.)	5·37	5·00
London and S.E. (including Chatham, Aldershot and Brighton)	6·81	6·69
East Coast (Newcastle down to East Anglia)	6·99	6·65
Industrial North Central (Chesterfield, Derby, Nottingham, Leeds, Northampton, etc.)	7·43	7·31
W. Scotland and N.W. England (Glasgow, Ayr, Carlisle, Barrow, etc.)	7·72	7·31
Industrial N.W. (Stoke, Liverpool, Manchester, Wrexham, etc.)	7·72	7·41
South Wales and Somerset	7·76	7·41
S. Central (Shrewsbury, Birmingham, Hereford, Oxford, Reading, etc.) ..	8·86	8·65
S.W. England (Portsmouth, Salisbury, Plymouth, etc.)	9·45	9·21

Analysis of variance shows that differences be tween areas are statistically significant, when com pared with variations within areas. The *F*-ratio i 6·19 with 8 and 70 degrees of freedom; a ratio o 3·8 would have a probability of 0·001.

The figures suggest that colour defect may b racially connected with pigmentation, since it i generally accepted that light hair and eyes are mor prevalent in the north and east, dark colouring i the south and west of Great Britain. While no possible in war-time, we hope later to be able t compare our results in detail with figures for th geographical distribution of blonde versus brunett characters.

It should be noted that the total percentage for a areas of 7·49 per cent is much higher than the usua estimate of about 4 per cent for males, simply be cause the test employed is a difficult one which pick out many of the colour-weak, or anomalous tr chromats, as well as the strictly colour-blind.

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Instability of Stilbamidine in Aqueous Solution

THE changes which stilbamidine and related com pounds undergo in solution on exposure to the actio of light have received considerable attention in th last two years, and several publications dealing wit the subject have appeared in the literature, fror which it seems that the methods of approach hav been biological and physical rather than chemica Fulton and Yorke[1], Fulton[2], Barber, Slack and Wien and Goodwin[4] have contributed to the elucidation of the changes which occur, and the present position may be summed up briefly as follows. Stilbamidine and, to a rather less extent, its monomethyl derivative, undergo profound chemical change under the action of light, which change is accompanied by a large increase in toxicity, loss of therapeutic activity and disappearance of those properties (characteristic light absorption and capacity for reacting with bromine and permanganate) which are attributable to the ethylenic linkage. The 4 : 4′-diamidino derivatives of dimethyl stilbene, tolane, diphenyl ethane and diphenoxy pentane undergo little or no change on exposure to light.

The explanation proposed by Barber, Slack and Wien[3] to account for these changes in the case of stilbamidine is the addition of the elements of water to the double bond of the stilbene portion of the molecule with the formation of 4 : 4′-diamidino phenyl benzyl carbinol. These authors produce considerable evidence in support of their explanation of the observed phenomena ; but it would seem that they themselves are not entirely satisfied with this explanation, though it certainly accounts satisfactorily for many of the observed facts relating to the changes. They deduce from their observations that the amidine groups are not affected, the change being associated solely with the unsaturated stilbene linkage.

A considerable amount of work has been carried out here both with solutions exposed for long periods to diffuse daylight and with solutions exposed for much shorter periods to direct tropical sunlight, the results of which it is hoped to publish in detail elsewhere. The rapidity with which the primary changes take place on exposure to direct irradiation (insolation in this case), found by other workers, has been confirmed, and observations made here are essentially in agreement with the already published results relating to the disappearance of those properties attributable to the ethylenic linkage. There are, however, reasons for believing that the principal product of irradiation is not the diamidine of phenyl benzyl carbinol, as Barber, Slack and Wien[3] suggest, and an alternative explanation, for which there is some experimental evidence and theoretical support, is proposed below.

As regards the changes which stilbamidine undergoes in solution on prolonged exposure to diffuse daylight, it has been definitely established that the amidine groups are, under these conditions, not stable and undergo hydrolysis and conversion into amido groups with the liberation of ammonium chloride. The primary products of irradiation, which are at least two in number, and the stilbamidine not so converted all appear to undergo this slow hydrolytic process, so that old solutions contain a complex mixture of compounds which, with a few exceptions, do not show wide differences in chemical and physical properties. Two, at least, of these hydrolytic products have been isolated and characterized with fair certainty, namely, 4-amido : 4′-amidino-stilbene monohydrochloride (most probably the trans-form) and 4 : 4′-diamido-stilbene. There is reason to believe that, under our climatic conditions, *cis*-stilbamidine is one of the primary products of irradiation, and that it, and the products of its hydrolysis, persist in solution throughout the consecutive processes of the fractionation of the chlorides and of the sulphates of the constituents of old solutions. The presence of ammonium chloride in these solutions has been confirmed, and there is evidence that adsorption of the stilbamidine base, and other bases, on the glass, and base-exchange, play an important part in these hydrolytic processes. It is quite probable that they are dark reactions.

Further hydrolysis of the amido groups with the formation of ammonium carboxylate groups could take place, but there is at present no evidence that this has occurred under the conditions of neutrality which these old solutions maintain.

It appears from the literature that, although the most frequent behaviour of geometrical isomers on irradiation involves partial conversion of the more stable configuration (usually the *trans*-form) into the less stable configuration, other courses which may be followed are the addition of the solvent at the double bond and polymerization, which latter may be a straightforward dimerization, as in the case of the cinnamic acids, which can dimerize to form truxinic and truxillic acids. This last course seems to be common with ethylenic derivatives of fairly high molecular weight.

There is experimental evidence, as yet by no means conclusive, that under our conditions the principal primary product of the insolation of stilbamidine in aqueous solution is a dimer of stilbamidine, and not diamidino phenyl benzyl carbinol, and that *cis*-stilbamidine is also formed to some extent. The dimer would be 1,2,3,4-tetra (4′-amidino phenyl) cyclobutane, and its anhydrous salts would have the same composition as the corresponding anhydrous salts of stilbamidine. The dimerization— if it occurs —may be of the original stilbamidine or of the *cis*-modification of stilbamidine, which may be the true primary product of irradiation. The kinetics of the reaction, which it is hoped to examine in detail shortly, may throw light on this point.

The above view of the changes brought about in stilbamidine by the action of light allow of some interesting deductions to be made. The dimerization of stilbamidine, in either the *cis*- or *trans*-form, should, from the point of view of steric hindrance, be able to take place more readily than should that of the mono-methyl derivative, and much more readily than that of the dimethyl derivative, which agrees with the observed differences in behaviour of these compounds on irradiation. Fulton[2] himself was not entirely satisfied with his explanation of the difference in behaviour of these compounds and would, one suspects, have preferred to have been able to attribute the difference to steric hindrance.

What may be a more important inference is that a compound of similar structure to stilbamidine, but without its tendency to undergo either *cis-trans* isomerization or polymerization, may have all the therapeutic qualities of stilbamidine—which are undoubtedly good—with none of the disadvantages which attend the latter in practical use, particularly in the tropics. The diamidino derivative of 2-phenylindene, namely, 2-(4′-amidino phenyl)-6-amidinoindene, should be such a compound. By virtue of the *ortho*-ring closure this compound must have the equivalent of the *trans*-configuration, similar to stilbamidine, while at the same time conversion to a *cis*-modification is out of the question. Furthermore, from considerations of steric hindrance, this compound is unlikely to be able to undergo any significant degree of polymerization similar to that which it appears may occur in the case of stilbamidine and its monomethyl derivative. The indene derivative depicted above is, in effect, a 'frozen' form of 4 : 4′-

diamidino monomethyl stilbene. If this compound can be synthesized, examination of its therapeutic activity, toxicity and stability in solution under the influence of light is likely to yield results of considerable theoretical and practical interest.

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[1] Fulton, J. D., and Yorke, W., *Ann. Trop. Med. Parasitol.*, **36**, 134 (1942).

[2] Fulton, J. D., *Ann. Trop. Med. Parasitol.*, **37**, 48 (1943).

[3] Barber, H. J., Slack, R., and Wien, R., Nature, **151**, 107 (1943).

[4] Goodwin, T. W., *Ann. Trop. Med. Parasitol.*, **37**, 59 (1943).

Transmission of Susceptibility to Carbon Dioxide to Species Hybrids in Drosophila

L'Héritier and Teissier[1] have described a stock of *Drosophila melanogaster* the flies of which die when exposed for five minutes to carbon dioxide at temperatures between 1° and 23° C., whereas other flies of the species recover from such treatment after a few minutes[2]. This susceptibility, S_{CO_2}, or its normal counterpart, resistance to carbon dioxide, is transmitted to the offspring as one unit, but it is not fixed to any of the chromosomes and therefore cannot be regarded as a Mendelian character. In crosses between flies from L'Héritier's stock and normal flies, susceptibility to carbon dioxide is transmitted to the whole offspring by the mother, but only to part of the offspring by the father. Some of the latter's susceptible daughters, but not the sons, may in turn transmit it to their offspring. No individual resistant to carbon dioxide has been observed to transmit susceptibility.

Sturtevant[3] has described sterile hybrids between *D. melanogaster* and *D. simulans*. 10–40 per cent of his crosses *melanogaster* ♀ × *simulans* ♂ produced offspring, predominantly female, but not more than 2 per cent of the reciprocal matings were successful and the offspring from those was predominantly male. From this the conclusion is drawn that hybrids do not survive, unless they carry a *simulans* X-chromosome. Later experiments by Biddle[4] yielded a higher percentage of offspring from the crosses *simulans* ♀ × *melanogaster* ♂, especially when a *simulans* stock containing the mutant black was used.

The above results made it possible to attempt the transmission of the susceptibility to carbon dioxide from L'Héritier and Teissier's original ebony S_{CO_2} stock (*D. melanogaster*) to hybrids from this stock and a stock of *D. simulans*, homozygous for the mutant black. The results of these experiments are summarized in Tables 1 and 2.

Crosses were set up in bottles or vials in pairs of five and kept at 25° C. The exclusively male offspring from the cross *simulans b*♀ × *melanogaster* eS_{CO_2} ♂ emerging at this temperature was characterized by its wild-type colour and some deficiencies in bristles, and could thus readily be distinguished from illegitimate offspring, resulting from non-virgin *simulans b* ♀♀. From the cultures containing reciprocal crosses which had to be kept at 20° C. after pupation, wild-type coloured females emerged which showed some roughening of the eyes. No illegitimate offspring occurred in these cultures.

Table 1 summarizes the results of the carbon dioxide treatment of female offspring from eight mass cultures *melanogaster* eS_{CO_2} ♀ × *simulans b* ♂; control flies of the eS_{CO_2} stock always died, *simulans b* and *melanogaster* or + flies survived. Thus the hybrids from at least seven matings, probably from many more, showed susceptibility to carbon dioxide; whether the resistant flies from culture 3 were all descendants from one mating cannot be decided. Many of the susceptible flies from this culture took a longer time to die after treatment than usual.

Table 1. After 5 minutes in 100% CO_2 at 13°–15° C.

No. of culture	Dead	Recovering
1	41	—
2	71	—
3	118	15
4	65	—
5	17	—
6	23	—
7	87	—
8	29	—

Table 2. After 5 minutes in 100% CO_2 at 13°–15° C.

No. of culture	Dead	Recovering
1	19	45
2	3	7
3	34	12
4	34	33
5	6	15

Table 2 summarizes the results of identical treatment of the offspring of five mass cultures *simulans b* ♀ × *melanogaster* eS_{CO_2} ♂, and its figures suggest, although they do not prove, that the offspring from a mating of this type may contain resistant and susceptible flies in varying proportions. This was also observed in the offspring from two successful paired matings, where the proportions of susceptibles to resistants were 10 : 3 and 12 : 9 respectively.

It thus appears that the susceptibility to carbon dioxide of a stock of *D. melanogaster*, as described by L'Héritier and Teissier, can be transmitted to the crosses between this species and *D. simulans*. In accordance with its intraspecific inheritance, the character is as a rule transmitted to all the interspecific hybrids by the mother, but only to part of the hybrid offspring by the father.

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Nov. 11.

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[1] *C.R. Acad. Sci. Paris*, **205**, 1099 (1937); **206**, 1193, 1683 (1938).

[2] *J. Exp. Biol.*, **19**, 238 (1942).

[3] *Carnegie Inst. Publ.*, No. 399 (1929).

[4] *Genetics*, **17**, 153 (1932).

Terminology of Nucleic Acids

Altmann (1889) suggested the term 'nucleic acid' for the acidic substance of high phosphorus content which Miescher had isolated from the nuclei of pus cells and fish spermatozoa. Nucleic acid was a very useful biological term so long as it was clear that it referred to material from the cell nucleus; but the subsequent extensive researches on nucleic acids by Kossel and his school, by Levene and by others, were largely chemical, and ignored the question of what part of the cell might be the source of these substances (see Mirsky[1] for literature). As a result o these investigations, the chemistry of nucleic acid became well known; and although no longer a useful biological word in its original sense, the term 'nucleic acid' has to-day a well-defined chemica significance, referring to the natural tetranucleotides

There are two types of nucleic acid; and both are of very wide, perhaps universal, occurrence in ving organisms. The chief chemical difference beween them lies in the carbohydrate part of the ucleotide: in one nucleic acid it is a pentose, *d*-ibose; in the other it is a desoxypentose, *d*-riboesose. The two nucleic acids are therefore called by hemists ribose and desoxyribose. The only biological erms equivalent to ribose and desoxyribose refer to he sources from which the two acids are most freuently isolated. Ribose nucleic acid is called 'yeast ucleic acid', and the desoxyribose type is called hymus nucleic acid'. Since the former was originally btained from yeast plants, while the latter was most adily available from the thymus glands of animals, ne acids are also called 'plant nucleic acid' and 'animal ucleic acid' respectively, with the distinct implicaon, indeed sometimes the direct statement, that ese two terms express the true difference in distribuon of the two nucleic acids in living organisms.

We now know that this is wholly misleading. ibose nucleic acid is not restricted to plant tissues, or desoxyribose to animal tissues; both occur idely in both animals and plants. Indeed both the ast cell and the thymus gland cell undoubtedly ntain both acids. Thus, as biological terms, 'yeast cleic acid' and 'thymus nucleic acid' are to be oided to-day; and some contemporary writers efer to use the biologically quite non-committal rms 'ribose' and 'desoxyribose'.

It seems to us that recent work has made the stinctive distributions of the two nucleic acids clear ough, so that the introduction of a new terminology r biological use is justified. From studies of the ghly specific nucleal reaction of Feulgen, from ehrens' work on the separation of nuclear and cytoasmic constituents of the cell, from the results of otochemical analysis, especially by Caspersson, d from direct analysis by us of chromatin itself, it now clear that desoxyribose nucleic acid is normally stricted to the chromatin of the cell nucleus, and at the chromatin contains none of the ribose type nucleic acid. We therefore suggest that *chromocleic acid* be used instead of 'thymus nucleic acid' a biological term for the substance described emically by the term 'desoxyribose nucleic acid'. is now certain that the ribose nucleic acid, by ntrast, is found either in the cell cytoplasm or in e plasmosome (nucleolus) of the cell nucleus; it not a constituent of the nuclear chromatin itself. e therefore suggest *plasmonucleic acid* as a useful bstitute for 'yeast nucleic acid' and as the biological uivalent for the chemical term 'ribose nucleic acid'.

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Mirsky, A. E., "Advances in Enzymology", 3, 1-34 (1943).

A Specific Reaction for Ascorbic Acid

ON adding hydrochloric acid to a solution of corbic acid, reversible oxidation with 2 : 6-dichloroenolindophenol and iodine becomes progressively wer as the mineral acid content increases. When e hydrochloric acid concentration reaches 20 per nt in the case of indophenol and 29 per cent in the se of iodine, reduction of the reagent is completely ibited. On diluting the acid mixture with water, e total reducing capacity of the ascorbic acid is restored, and can be titrated with both reagents. This property is exhibited only by ascorbic acid, and, consequently, substances which interfere in the titration under the usual conditions can be differentiated from the vitamin. With certain other reducing substances the rate of reduction of the reagents is somewhat retarded, but reduction proceeds to completion. With orange juice a small titration is observed in the presence of the mineral acid, and the true ascorbic acid content is obtained either by subtracting this figure from the original titration value or by determining the renewed titration value obtained on diluting with water. With fruits and vegetables of high vitamin content (guava, lucerne and parsley) no interfering substance is found to be present.

The method is particularly useful with glucoreductone produced from glucose and hot alkali, as this substance under the usual conditions of titration is indistinguishable from ascorbic acid. By keeping the hydrochloric acid concentration at 20 per cent this reductone can be titrated with indophenol to completion, the pink colour persisting for 20 sec. at the end-point. With iodine in the presence of 29 per cent acid the titration is not accurate. The high apparent ascorbic acid figure produced with metaphosphoric acid extracts of biscuit, to which concentrated orange juice had been added, was definitely proved to be due to a reductone-like substance only.

Thiosulphate can be differentiated from ascorbic acid similarly using indophenol or iodine. Certain modifications are necessary in applying the method to urine analyses. The new technique provides (*a*) a simple method by which ascorbic acid can be identified in solution, and (*b*) in the case of unknown material, fresh evidence as to whether ascorbic acid is the reducing substance present.

A suggested explanation of the phenomenon is that in the presence of an abundance of hydrogen ions ascorbic acid is completely converted into the non-reducing keto-form. On dilution with water, enolization results with a restoration of the reducing capacity.

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Anabiosis in a Soil Ciliate

INVESTIGATORS of the microfauna of the soil have frequently remarked upon the rapidity with which active ciliates make their appearance when samples of dried or partly dried soil are moistened for examination in the laboratory. The conclusion has been drawn that these ciliates cannot be in the encysted condition but are capable of remaining active in soils containing a very low percentage of water.

Some light has been thrown on this matter in the course of recent investigations on the bionomics of a little-known holotrichous ciliate, *Balantiophorus minutus* Schew., which has been frequently reported from soil. In agar plate cultures of this ciliate, it was observed that not only could it remain active in very restricted films of water, wriggling between the bacterial masses on the surface of the agar in an almost amœboid fashion, but also that it was capable of passing into a condition of suspended animation.

without the formation of any cyst, when the free water completely disappeared from the agar surface. This phenomenon appears to be comparable with the condition of anabiosis shown by Tardigrada and other animalcules of the moss fauna, and so far as I have been able to discover, it has not previously been reported for any ciliate. In this condition the body of the ciliate has a shrivelled and flattened appearance and shows no signs of life. It is, however, capable of revival within periods of up to three weeks, provided that it is in contact with some moisture-retaining substance, and that the relative humidity is high. Immediately upon the addition of water, the cilia commence to beat, the organism starts to swim about, and in a period varying from ten minutes to an hour it has regained its normal form and activity.

Balantiophorus minutus is thus peculiarly well fitted for life in the surface soil, where the amount of free water is subject to frequent and drastic alteration, and is at all times limited save in water-logged soils. It is not unlikely that upon further investigation other soil ciliates will be found to possess a similar power of temporary resistance to desiccation.

A fuller account of this work is in the course of preparation, and it is hoped that it will appear shortly.

In conclusion, it may not be out of place to remark that *Balantiophorus minutus* shows a similar ability to cause flocculation of the bacteria on which it feeds to that reported in these columns for *Oikomonas termo* by Hardin[1] and for Epistylis and Vorticella by Pillai and Subrahmanyan[2].

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[1] NATURE, **151**, 642 (1943).

[2] NATURE, **150**, 525 (1942).

Hitherto Unidentified Absorption Bands of Water Vapour

IN 1912–13, F. E. Fowle[1] made studies of the absorption of infra-red radiation by water-vapour at 0·93 μ, 1·13 μ and 1·47 μ, in order to determine spectroscopically the total water-vapour content of the atmosphere. The first two wave-lengths are at the centres of the ρ and φ bands; the last is about 450 cm.$^{-1}$ from the ψ-band centre.

Recently, studying the rotation-band of water-vapour numerically, I found a striking difference in absorption near the band-centre and at the wing. Assuming a line-width 0·4 cm.$^{-1}$, I found that, to increase the absorption from 20 to 80 per cent, a 25-fold increase in the quantity of absorbing vapour is needed near the band-centre, but a 40-fold increase is needed near the wing. Fowle's results indicate a 25-fold increase at each of the three wave-lengths. This suggests that the absorption at 1·47 μ may be due to a hitherto unidentified band, centred near 1·47 μ. It is, in any event, improbable that the ψ-band should give absorption more than 450 cm.$^{-1}$ from the band-centre, when the much stronger band centred at 6·3 μ extends, on the long-wave side, only 400 cm.$^{-1}$ from its centre.

Mecke's empirical formula[2] suggests that the new band is the band $\nu_3 + 2\nu_2$ ($\nu_\sigma + 2\delta_\pi$), centred about 1·455 μ. To test this, energy-levels for $\nu_3 + 2\nu_2$ were estimated roughly by extrapolation from Nielsen's data[3] for ν_2, $2\nu_2$, ν_3, $\nu_3 + \nu_2$, and those of Randall, Dennison, Ginsburg and Weber[4] for the rotation-band. These gave rough positions for the important lines in the band, which were found to be about 5 cm.$^{-1}$ below the positions of lines observed in sunlight by Abbott and Freeman[5]. The computed energy-levels were increased by about this amount, when it was found that all strong lines predicted between 1·44 μ and 1·48 μ were actually observed, and no others. This establishes the correctness of the identification. The lowest energy-levels are tabulated below.

0_0	6876 cm.$^{-1}$	2_0	6978 cm.$^{-1}$	3_0	7096 cm.$^{-1}$
1_1	6922	2_{-1}	6961	3_{-1}	7055
1_0	6918	2_{-2}	6945	3_{-2}	7022
1_{-1}	6899	3_3	7222	3_{-3}	7019
2_2	7031	3_2	7221		
2_1	7030	3_1	7113		

The new band has evaded detection so far becaus of its weakness, which makes it hard to observe i the laboratory, and its proximity to the ψ-band Other weak bands can, probably, also be identifie in sunlight. The lines observed by Langley[6] a 2·115 μ and 2·1645 μ are probably the maxima o the two wings of the 'butterfly' band 3 ν_2, and th lines found by Abbott and Freeman[5] between 1·178 and 1·21 μ probably arise from the band $\nu_3 + 3\,\nu$ centred near 1·192 μ. Each of these bands is, howeve overlapped by stronger bands, which have hithert masked their presence.

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Oct. 29.

[1] Fowle, F. E., *Astrophys. J.*, **35**, 149 (1912); **37**, 359 (1913).

[2] Mecke, R., *Z. Phys.*, **81**, 313 (1933).

[3] Nielsen, H. H., *Phys. Rev.*, **59**, 565 (1941); **62**, 422 (1942).

[4] Randall, H. M., Dennison, D. M., Ginsburg, N., and Weber, L. R *Phys. Rev.*, **52**, 160 (1937).

[5] Abbott, C. G., and Freeman, H. B., *Smithson. Misc. Coll.*, **82**, No. (1929).

[6] Langley, S. P., *Ann. Astrophys. Obs.*, **1**, table 23 (1900).

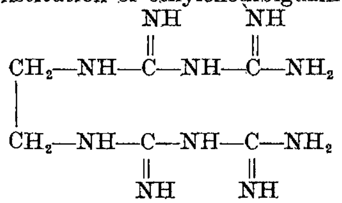
Composition and Constitution of Ethylenebiguanide

IN a previous note on "A New Type of Comple Silver Compounds with Tervalent Silver"[1], the con position of ethylenebiguanide was represented as th given by Dittler[2] as well as by Dübsky and c workers[3]. This is, however, not correct. It has no been found that the so-called ethylenebiguanide, prepared by us following the method described Dittler and also by Dübsky and co-workers, is real an ethylene dibiguanide, En(BigH)$_2$, of the con position $C_8N_{10}H_{16}$. It behaves as a quadridenta molecule with four points of attachment to the ce tral silver atom instead of being bidentate like t so-called ethylenebiguanide. This difference was n detected before, as we had no reason to suspect t composition of the compound and satisfied ourselv only with the estimation of nitrogen and sulpha in a sample of the substance, which, however, agre with those given by Dübsky and co-workers. subsequent estimation of carbon and water both the substance under discussion and in its compl silver salt revealed this difference; 2 $C_4N_5H_9.H_2S$ gives almost the same values for nitrogen a sulphate as $C_8N_{10}H_{16}2H_2SO_4.1{\cdot}5H_2O$.

Therefore, the constitution of the tervalent silv complex should now be represented as:

$$[\mathrm{Ag^{III}En(BigH)_2}]\ X_3,$$

and the constitution of ethylenedibiguanide as :



$$\begin{array}{l} \mathrm{NH}\mathrm{NH} \\ \,\|\| \\ \mathrm{CH_2—NH—C—NH—C—NH_2} \\ | \\ \mathrm{CH_2—NH—C—NH—C—NH_2} \\ \,\|\| \\ \mathrm{NH}\mathrm{NH} \end{array}$$

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Sept. 25.

[1] Nature, 151, 643 (1943).

[2] Dittler, *Monatsh.*, 29, 647 (1908).

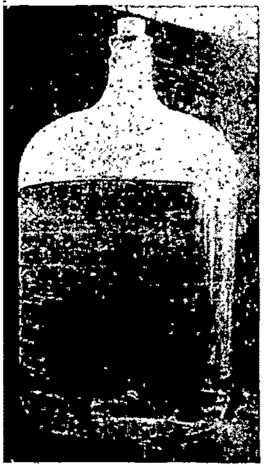
[3] Dübsky, Langer and Strand, X, 111 (1938).

Surface 'Memory' in a Carboy

Toward the close of a recent afternoon, we calibrated a cleaned, dry 5-gallon carboy by pouring in successive litres of distilled water. During the next morning, we found that the bottom 13 litre-levels had been 'remembered', these levels being precisely marked by the lines of gas bubbles shown in the photograph. We had not previously encountered the phenomenon, nor have we seen it described.

The gas released must have been carbon dioxide. At the time, the *p*H of our distilled water could be ncreased from 4·7 to 6·8 by boiling. Furthermore, the bubbles marking most of the levels were 'fixed' as continuous white lines, presumably of barium carbonate, when dissolved barium hydroxide was added to the undisturbed carboy.

Several successful attempts to reproduce the phenomenon gave some clues to its mechanism. Successive litres of water were poured into each of several carboys through extended funnels, about 10 seconds being required for the pouring and 2 minutes for the filling of the graduate. While this was going on, gas bubbles rose from the floor of the carboy to the surface of the water. Owing to a gentle swirling motion, the smaller bubbles occasionally came into contact with, and adhered to, the walls. During the 2-minute interval, enough pin-point size bubbles were usually captured by the walls to give an almost continuous line marking each level below the topmost. Such lines could usually be seen while the next litre of water was being poured in ; at least once, however, they did not appear until some time later, perhaps because the bubbles adhering were initially so small as to escape observation. The bubbles eventually grew to a diameter near 1/8 in., whereupon they escaped into the gas space over a period of days. Those marking the upper levels disappeared first, probably because the buoyant force acting on them was greatest. (Disappearance of the bubbles owing to re-solution of the carbon dioxide seems less likely.) The phenomenon was observed also in a carboy the walls of which had been wet before the experiment was begun.



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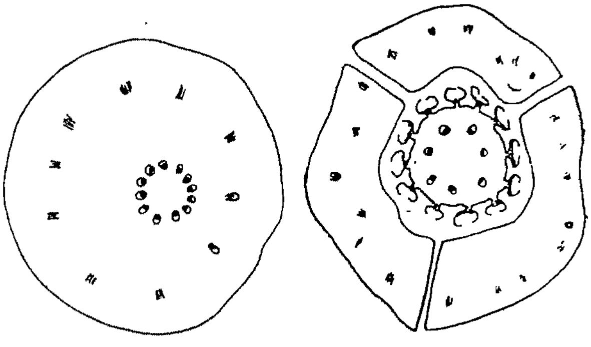
Origin of the Trimerous Perianth

The trimerous perianth being one of the characteristic features of the monocotyledons, its origin is an important problem of floral morphology. Salisbury[1], from detailed studies of meristic variations among the floral parts of the Ranunculaceæ and Helobiales, has come to the conclusion that trimery is really the most primitive condition among the angiospermous flowers. The pentamerous whorl, according to him, has evolved from two trimerous whorls by the fusion of one member of the outer and one member of the inner whorl. A study of the vascular anatomy of the male flowers of *Myristica fragrans* Houtten, Fam. Myristicaceæ, however, leads to a quite contrary view. This family is phylogenetically not far removed from the Ranunculaceæ and is usually included among the Ranales. Its diœcious flowers possess a tubular or campanulate perianth, which divides above generally into three lobes. The serial transverse sections of the male flowers of *Myristica fragrans* show that the trimerous perianth is supplied by ten vascular traces (Fig. 1). Such a vascular supply is clearly of a pentamerous whorl.



Myristica fragrans
1, transverse section of a male flower showing ten perianth traces ; 2, the same at a higher level after division of the perianth tube into three valvate segments. In the centre is the anther-bearing column.

There is thus in this case evidence that the trimerous perianth has been derived from a pentamerous whorl. How the change has occurred is not shown so definitely, but the size of the perianth-lobes points the way. Two of the perianth-lobes are much larger than the third (Fig. 2). This suggests that each of the larger lobes has been derived from the fusion of originally two separate perianth leaves. The persistence of the original pentamerous vascular supply even after the establishment of the trimerous condition in the perianth also favours the view that the change has been brought about by the fusion of certain parts rather than by the suppression of two members.

A. C. Joshi.

Benares Hindu University.
Aug. 1.

[1] Salisbury, E. J., *Ann. Bot.*, 33, 47 (1919) ; 34, 107 (1902) ; 40, 419 (1926) ; 45, 539 (1931).

RESEARCH ITEMS

Salmon of the River Shannon

Arthur E. J. Went has continued his researches on Irish salmon (*Proc. Roy. Irish Acad.*, **49**, Sect. B, No. 9; 1943). The work was undertaken in order to ascertain the differences in the stocks since the completion of the great dam at Partean on the River Shannon in 1929, which marked the beginning of a new stage in the history of the river as a habitat for salmon. After a few years the stocks of salmon in the river had decreased considerably in consequence of the construction and early operation of the hydro-electric plant. Apart from this decrease in numbers, which was of considerable importance both biologically and commercially, there is ample evidence that the characters of the stocks have also changed within the past twelve years or so. In 1940 a new fishing weir, known as the Thomand Weir, was completed, and this provided satisfactory facilities for the collection of suitable material for study. The incoming populations of the years 1927 and 1928 were compared with those of 1941. The incoming populations of 1941 were well conditioned and differed little from the pre-1929 runs. The following differences were found in the 1941 stock: average age of the smolts somewhat higher; a much larger proportion of grilse in the total runs; a much larger proportion of the total catch taken in June; total age of the fish more than a year less, three-year old fish predominating instead of four-year olds; and a considerable decrease in average weight due to the greater proportion of grilse.

Australian Freshwater Mollusca

Tom Iredale has produced a "Basic List of the Freshwater Mollusca of Australia" (Contributions from the Australian Museum, Sydney, N.S.W., *Australian Zoologist*, 10, Part 2; 1943). This is a sequel to the list of land Mollusca previously published in the same journal. The fundamental idea is to determine the relation between shell and environment. The shell characters vary much according to habitat. The study is of undoubted value, for many of these snails might serve as hosts for economically important parasites, especially trematodes. Some systematists may doubt whether the introduction of so many new generic and specific names can have any useful purpose, and they will hope that such names are not generally adopted without the most careful consideration.

Polyploidy in the Red Algæ

In the Floridean red algæ, in addition to the usual haplobiontic and diplobiontic types of life-cycle, using the terms suggested by Svedelius, a few species bear sexual organs and tetrasporangia on the same filaments. In *Spermothamnion Turneri* (Mert.) Aresch., Miss Drew (*Ann. Bot.*, 7, 25; 1943) finds sexual organs on tetrasporic and on normal haploid plants, and also on the haploid individuals degenerate sporangium mother cells. Since sex cells occur on haploid and diploid plants, the carposporophyte may be diploid, triploid or tetraploid; the diploid and triploid carpospores are viable, but tetraploid plants have not been recognized. The only previous case of triploidy in a member of the Florideæ was reported by Drew in 1939 in *Plumaria elegans*, where the plants are maintained by paraspore production. In *Spermothamnion Turneri* the triploid plants do not appear to fit into the life-cycle, though some evidence suggests that tetraspores may be formed on them. Miss Drew has studied this species in Great Britain and at Wood's Hole, and triploid plants have been found on both coasts. It is of interest to recognize these cases of polyploidy in Florideæ, and cytological investigation of other aberrant types should prove of interest. Such studies also emphasize the ability of plants of this group to produce similar plants and reproductive organs irrespective of the cytological condition of the tissues.

Sweet Clover Hybrids

W. K. Smith (*J. Hered.*, **34**, 134; 1943) finds that the sweet clover hybrids *M. alba* × *M. dentata* are chlorophyll-deficient and soon die. By grafting these hybrids on *M. officinalis* they were raised to maturity and a few seedlings obtained by backcrossing the hybrids to *M. alba*. These backcross progeny are also weak, but it may be possible to transfer by this novel method the coumarin-free character of *M. dentata* to *M. alba* and thus provide a valuable economic plant. It is interesting to note that there appears to be stock-scion incompatibility between some plants of *M. officinalis* and the hybrids.

High Rate of Mutation

K. Mampell (*Proc. U.S. Nat. Acad. Sci.*, **29**, 137; 1943) finds that the progeny of a pair of *Drosophila pseudo-obscura* Race *B* had an abnormally high rate of mutation. About 2,000 mutations and nearly all types of characters have been found. A gene 'mutator', probably located on chromosome II, appears to be responsible for the increased mutation-rate. When heterozygous, the rate is 34 times that of the normal rate, and when homozygous it increases the rate 70 times: there is a linear response to loss of gene. The significance of such gene effects in evolution is important.

Instrument Transformers

In a paper on this subject read in London before the Institution of Electrical Engineers on November 19, A. Hobson discusses ratio and phase-angle errors and means whereby improved accuracies may be obtained. Section 1 describes a new method of reducing current-transformer errors, using a compensator which may be either an integral part of the transformer or a separate unit for use with an existing transformer. The compensator employs normal design principles and does not depend on highly critical conditions such as saturated cores. Very high accuracies are obtained, and standard transformers may be constructed having almost unmeasurably small errors over the whole current range, using the most sensitive testing equipment. In Section 2 a method of testing voltage transformers is described in which the Arnold current transformer equipment may be adapted for this purpose. The set measures the difference in error between a standard and the test transformer. Section 3 deals with the estimation of the errors of three-phase star/star voltage transformers at their working burdens, from the results of tests at unity-power-factor burdens. Two methods are given, the first using the six phase-to-neutral test results usually provided by manufacturers, and the second, in which no three-phase calculations are involved, using the results of twelve special tests i three phases are to be loaded or of six tests if only two phases are to be loaded.

Stellar Continuous Spectra

A PROTRACTED investigation of the continuous radiation emitted by stars has been conducted in France during the last decade by MM. Barbier and Chalonge and their collaborators. The work was finished just before the German occupation and the results have apparently been printed in *Annales d'Astrophysique* (**4**, 1; 1941). A corrected proof has now reached the United States, and an article by J. L. Greenstein (*Astrophys. J.*, **97**, 445; 1943) summarizes the authors' conclusions, and reprints in full their numerical results. The measurements were made on the energy distribution in the ultra-violet spectra of 204 stars, mostly of the early types, and are given in the form of two spectrophotometric gradients φ_1 and φ_2 for the regions to the red and to the violet of the Balmer limit respectively. Zero points for the observed gradients were obtained by comparing the spectra of the stars with the continuum given by hydrogen discharge tubes, which were themselves frequently compared with standard filament lamps. The tabulated gradients have an average probable error of about $\pm 0 \cdot 04$ for spectral types earlier than *G*0. Also tabulated are the values of the discontinuity *D* in the logarithm of the intensity on crossing the Balmer limit: on the average, these have probable errors of $\pm 0 \cdot 01$. The mean gradients for 17 normal *A*0 stars are given as $\varphi_1 = +1 \cdot 00$ (colour temperature 16,500° K.) and $\varphi_2 = +1 \cdot 39$ (colour temperature 10,500° K.), the uncertainty here being of the order of $\pm 0 \cdot 10$ owing to the great difficulty experienced in accurately comparing the blue hydrogen tubes with the reddish filament lamps. Several variable stars were studied, and the effect of interstellar absorption on the shape of the energy distribution curves of reddened stars is discussed. The results throw doubt on the λ^{-1} law of interstellar absorption, which had been thought to be fairly well established. The paper concludes with a valuable table giving statistical data (φ_1, φ_2, *D* and their standard deviations) for normal stars arranged according to spectral type.

Movements in Chromospheric Eruptions

M. A. ELLISON has used his spectrohelioscope at Sherborne during the past two years to collect information on the lateral and vertical movements of chromospheric eruptions (*Mon. Not. Roy. Astro. Soc.*, 103, 1; 1943). 187 measures were made, on twenty-two eruptions, on the average at three-minute intervals, and the means show a red-shift for all values of line-width lying between 1·75 and 5 A. The red-shift is intimately connected with the growth and decay of each eruption, and is not inherent in the bright hydrogen from which the eruption is generated. Various reasons are given to show that a Doppler interpretation is very improbable, and it is suggested that the red-shift is an effect of asymmetry in the contour arising from increased absorption on the violet side of the emission line. On the supposition that the eruption is a centre from which matter capable of producing absorption is being expelled, it is probable that the amount of this matter and also the absorption produced by it will increase with the line-width and intensity of the eruption in accordance with the observations. The growth and decay of line-width during the progress of ten eruptions show that there is the same general sequence for all eruptions, namely, a rapid rise to maximum brightness and line-width is followed by a slow decline, the durations of rise and fall being in the ratio of about 1 to 4. In 95 eruptions there were no cases where lateral movements could be detected with any certainty. Where there were apparent lateral movements a satisfactory explanation could be found either by outward diffusion or by the fading of one part of the bright emission followed by an increase in brightness of an adjacent part.

Photographic Observations of Comets at Riverview College Observatory

D. J. K. O'CONNELL has described the results of the photography of five comets, Comet Finsler (1937*f*), Comet Kozik-Peltier (1939*a*), Comet Cunningham (1940*d*), Comet de Kock (1941*c*) and Comet van Gent (1941*d*) (*Mon. Not. Roy. Astro. Soc.*, **103**, 4). The instruments used were a 6¾-in. lens (focal length 130 cm.) and a 4-in. Ross-Grubb-Parsons lens (focal length 46 cm.), and, except for the plate of Comet van Gent, the telescope was guided on the comet. The plates were measured on the measuring machine at Mount Stromlo Observatory, by permission of Dr. Woolley, and the reduction was made by a method described by Dr. Comrie (*J. Brit. Astro. Assoc.*, **39**, 203; 1929). Each plate was reduced with two sets of three comparison stars, and a table gives the results of each solution, together with the comparison stars and their respective dependences.

Gradients and Colour Temperatures of γ Cassiopeiæ

D. L. EDWARDS has described the results of colour-temperature observations at the Norman Lockyer Observatory of γ Cassiopeiæ from June 1938 to October 1941, using objective-prism spectra of δ and γ Cass. (*Mon. Not. Roy. Astro. Soc.*, **103**, 4). Although the comparison star, δ Cassiopeiæ, is a variable, the range of magnitude is only 0·07, and it is probably of Algol type, so there seemed to be no reason why it should not be used for a gradient comparison, and it is probably devoid of temperature variation. The instrument used was the 12-in. McClean prismatic camera, stopped down to 4 in. to give convenient exposure time, and adjusted to give the spectrum in good focus at regions near $H\alpha$ and $H\gamma$. The instrument has a dispersion of about 32 A./mm. at $H\gamma$. Fast panchromatic plates which were specially made for the purpose were used, and these were sensitive to approximately 7000 A. The results are shown in a table which gives the gradient difference between the two stars in the sense γ-δ, after correcting for atmospheric extinction, the absolute gradient of γ, and the corresponding colour temperature, this latter being obtained by assuming the point 1·00 for the Greenwich zero. There is at first a fairly rapid decrease of gradient, implying an increase in colour temperature, and this continued until April 1939, after which there was a sudden change, with a slight average increase followed by a further fall in absolute gradient to a minimum in February 1940, when the temperature reached the high value of more than 24,000°. An interesting relation exists between gradient and the number of Balmer emission lines in the spectrum during one stage of the star's outburst, but this relation does not appear to be permanent. Various changes in the spectrum accompanied the gradient changes, a few of which are mentioned, but a detailed description of these will be dealt with in a later paper.

BINOCULAR AND UNIOCULAR THRESHOLD OF VISION

By Dr. MAURICE HENRI PIRENNE

Psychological Laboratory, University of Cambridge

It has been recently discovered[1] that, on account of the quantum nature of light, there occur at the absolute threshold of vision fluctuations of a purely physical nature which are large enough to account quantitatively for the variability of the response of the organism to the stimulus. The large magnitude of these fluctuations is due to the extreme smallness of the number of quanta which are active at the seat of action of light upon the nervous system, that is, which are actually absorbed by the retinal rods (5–14 quanta as an upper limit). Thus at the threshold, the magnitude of the physical stimulus varies at random from one trial to the next even when conditions are kept rigorously constant. Variations in the sensitivity of the organism may also occur, but clearly the physical fluctuations dominate the situation.

This of course refers to the uniocular threshold. Now, as regards the binocular absolute threshold, which is known to be slightly lower than the uniocular[2], the random nature of the stimulus variability suggests the following possibility. Defining the brightness threshold as the brightness at which the probability of seeing the light flashes is, for example, 0·50, we may ask whether the binocular is not lower than the uniocular threshold simply because the probability of receiving one stimulus of sufficient magnitude is greater when the subject is using two eyes than when he is using one, the two eyes acting as independent light detectors. It must be remarked here that "the fact that with two eyes there is a greater probability of the test field being seen than with one eye" has already been stated by Crawford[2] as an explanation in general terms of the small difference between binocular and uniocular absolute thresholds which he observed under static conditions, but the idea does not seem to have been further elaborated.

Experiment No.	Observed frequency of seeing			p_B calculated	$f_B - p_B$	σ
	Left eye	Right eye	Both eyes (f_B)			
I.	20/50 = 0·40	23/50 = 0·46	75/100 = 0·75	0·68	+ 0·07	0·047
II.	2/50 = 0·04	10/100 = 0·10	13/100 = 0·13	0·136	— 0·006	0·035
III. log. brightness = 1·1	11/25 = 0·44	8/25 = 0·32	14/25 = 0·56	0·62	— 0·06	0·10
log. brightness = 1·4	21/25 = 0·84	22/25 = 0·88	25/25 = 1·00	0·98	+ 0·02	0·028
IV. (pilocarpine)	6/25 = 0·24	10/27 = 0·37	12/25 = 0·48	0·52	— 0·04	0·10
V. log. brightness = 1·0	25/126 = 0·198	71/275 = 0·258	62/164 = 0·378	0·405	— 0·027	0·038

Measurements recorded on one horizontal line were made at one brightness level.

The numerator of the fractions is the number of flashes seen, the denominator is the total number of flashes tried: for example, in I, with the left eye, 20 out of 50 flashes were seen.

Each experiment was made at one sitting, except experiment V (see text).

Log. brightness = 1·0 (arbitrary units) corresponds to an actual test field brightness of 0·0047 e.f.c.

I have made experiments to test the above hypothesis in the particular case of the threshold of a small peripheral region of the dark-adapted eyes. The conditions resembled those used in the investigation by Hecht, Shlaer and Pirenne[1]. The circular test field (opal glass, 10′ in diameter) was placed 20° below a fixation point; it could be illuminated with white light for durations of 4 milliseconds. In each experiment the frequency with which the subject saw the flash with the left, with the right and with both eyes, at one or several brightness levels, was recorded. The natural pupils were generally used. When pilocarpine was used to contract the pupils to a fixed size, the results were similar in nature, as can be seen from the accompanying table.

According to the suggestion formulated above, theoretical calculations of the frequency of seeing with both eyes in terms of the frequency of seeing with the left and with the right eye were made. Let p_L, p_R and p_B be the probabilities of seeing with the left, with the right and with both eyes. Assume that the probabilities p_L and p_R are independent. It then follows from the definition of probability that

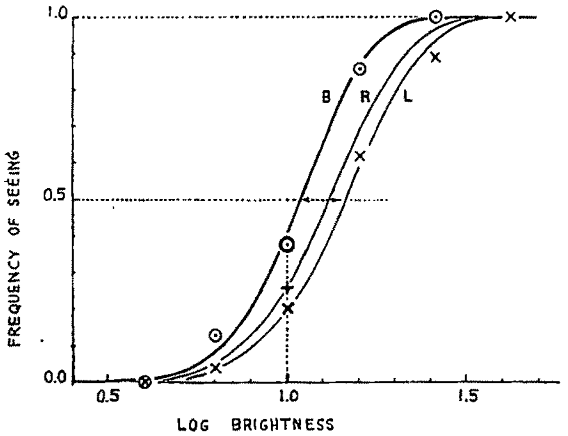
$$p_B = 1-(1-p_L)(1-p_R) = p_R + p_L - p_L p_R \qquad (1)$$

As an approximation to p_L and p_R, the observed frequencies of seeing with the left and with the right eye were used. The fifth column of the table contains the values so obtained. In a series of n flashes the standard deviation of the frequency of seeing to be expected theoretically on the basis of random variations is equal to $\sigma = \sqrt{p(1-p)/n}$. The values of σ are given in the last column of the table.

The table summarizes a number of experiments made on various dates. In experiments I to IV it is seen that the differences between the observed binocular frequencies f_B and the calculated values of p_B are of a magnitude to be expected according to the values of the standard deviation σ. The conclusion to be drawn, therefore, is that, within the experimental error, the facts agree with the hypothesis stated above. It may be pointed out that the reasoning would hold as well if the variability of the response were due primarily to biological, not to physical, fluctuations, provided the probabilities p_L and p_R are still independent.

If complete summation were to exist, the two eyes would behave as a single unit and the same result would be achieved by exposing both eyes to a certain brightness or exposing one eye to twice that brightness. In experiment III it was found that doubling the brightness of the flash in one eye raised the frequency of seeing from an average of 0·38 to an average of 0·86, while the binocular frequency for the former brightness was found to be only 0·56. This rules out complete physiological summation, and shows that the possible amount of partial summation, the existence of which cannot be ruled out because of the inaccuracies of the measurements, must be small in degree.

It is not practicable at one sitting to make enough trials to obtain accurate uniocular and binocular frequency curves. However, in a number of experiments done at intervals during a period of ten consecutive days, it was found that the frequencies of seeing obtained on different days did not show statistically significant differences: the results were accordingly treated as if they had been obtained at a single sitting. Experiment V represents the aggre-



THE THREE EXPERIMENTAL POINTS FOR LOG BRIGHTNESS = 1·0 REPRESENT THE VALUES OF EXP. V. THE OTHER EXPERIMENTAL POINTS CORRESPOND, FOR BOTH EYES, TO 85 FLASHES EACH (EXCEPT AT 0·6, WHERE IT WAS 50); FOR THE LEFT EYE, TO 50 FLASHES OR A FEW MORE EACH (EXCEPT AT 1·62, WHERE IT WAS 28). ⊙ BOTH EYES; + RIGHT EYE; × LEFT EYE.

gate result for the brightness level at which the largest number of flashes was tried. The observed binocular frequency agrees with the calculated one well within the standard deviation, which in this case is less than 4 per cent. Now it was found that the experimental frequency curve determined for the left eye agrees fairly well in shape with the theoretical curve calculated[1] on the basis of the Poisson equation for a retinal threshold $n = 6$ quanta. The same applies to the right-eye curve—the experimental points here have been obtained with fewer trials and are not reproduced in the figure. The following steps were then taken. First, theoretical curves R and L for $n = 6$ were drawn through the two points representing the uniocular data of experiment V. Secondly, the theoretical binocular curve B of p_B was calculated point by point in terms of the curves R and L, using equation 1. Finally, comparing with this curve B the experimental points for the binocular frequency of seeing, it is found that there is good agreement between the two. The data, therefore, fit the theory while making its implications clearer. The figure shows that, notwithstanding the absence of physiological summation, the binocular threshold as defined above is about 0·1 log unit below the mean of the uniocular thresholds. Again, the binocular frequency curve is steeper than the uniocular: the threshold for two eyes is more sharply defined than the threshold for one eye.

Under the present conditions, therefore, the results show that the barrier to be overcome by the stimulation must be situated below the fusion level of the nervous paths of the two eyes. The outcome of the experiments would be the same if the two eyes belonged to different persons, the flash being seen when at least one of the two persons has seen it. The situation closely resembles that found by Sherrington[3] in the case of binocular flicker.

The above, however, may not hold good under different sets of conditions[2]. The investigation will be continued when circumstances allow. Application of the same conceptions to the interaction between different regions of one retina also suggests itself, and is likely to have a bearing on the theory of all frequency of seeing curves.

I should like to thank Prof. F. C. Bartlett, Prof. E. D. Adrian, Dr. W. A. H. Rushton and Dr. K. J. W. Craik for their constructive criticisms. The apparatus used was purchased by the Medical Research Council. I am much indebted to Prof. Bartlett for the hospitality he gave me in his laboratory.

[1] Hecht, S., Shlaer, S., and Pirenne, M. H., *Science*, **93**, 585 (1941); *J. Gen. Physiol.*, **25**, 819 (1942). Hecht, S., *Biological Symposia*, VII, "Visual Mechanisms" (Lancaster, Pa., 1942); *J. Opt. Soc. Amer.*, **32**, 42 (1942).

[2] Crawford, B. H., *Proc. Roy. Soc.*, B, **128**, 552 (1940).

[3] Sherrington, C. S., "The Integrative Action of the Nervous System" (London, 1909).

PARASITOLOGY IN FREE CHINA

A TYPEWRITTEN copy of *Acta Brevia Sinensia*, No. 4, edited by the National Science Society of China (editor, Mr. Chentze H. Wu, Department of Physiology, College of Medicine, National Central University, Chengtu, Szechwan) has reached us by courtesy of the British Council. It contains an interesting article by K. Chang on parasitological research in free China.

Until recently, says the author, there was no medium in free China for the publication of original research in parasitology, and investigators in Szechwan have been cut off from the literature and have worked under very adverse conditions. Little has been done in the past on the parasites and parasitic diseases of man and animals in north-west, south-west and west China. Malaria has been a scourge in parts of south-west China, and the China-Burma Highway has aggravated the importance of this problem. American and other workers have studied it during the present War and have concluded that malaria is endemic in south-west China and that the malignant tertian parasite (*Plasmodium falciparum*) is responsible for 15–95 per cent of the cases. *Plasmodium vivax* and *P. malariæ* also occur, and *P. ovale*, described by Stephens in East Africa and thought by some to be a variety of *P. vivax*, has been recorded for the first time from China. *Anopheles minimus* is the chief vector of malaria, but a new species of malaria-carrying mosquito, *Anopheles kweiyangensis*, has been described from Kweiyang by Y. T. Yao and C. C. Wu.

Other protozoological work describes in Pehpei, near Chungking, a disease allied to Tsutsugamushi disease and caused by a Theileria-like organism; an endemic focus of kala-azar in the Sian region of Shensi province; and studies on the rather low incidence of *Entamœba histolytica* (5 per cent) in Szechwan, a curious result in the humid mild climate of this region; in North China with a dry climate and much better sanitation the incidence is 10–25 per cent, which is comparable with the 10 per cent incidence in the United States. Examination of wild rats in Chengtu, Szechwan, failed to reveal *E. histolytica* in them.

Helminthological work includes investigation of the endemic foci of schistosomiasis in Futsing, Fukien Province, and in the Tali-fu region in Yunnan. There is also the endemic area in the Yangtse Valley. Cases also occur in the Chengtu plain of Szechwan.

Fasciolpsis buskii has been found in Kunming, Yunnan, in eleven school-children and in one pig. Studies of hookworm disease show it to be an important problem in Szechwan and in Pehpei, near Chungking. Its relation to some local agricultural practices which favour its spread have been studied. *Hymenolepis nana*, which is not common in China, has been found in 2·4 per cent of persons examined in Sian, Shensi Province. *Trichostrongylus orientalis* has been found to be very common in Szechwan, 50 per cent of persons examined harbouring it in some localities; 11·7 per cent of school-children examined at Chengtu, Szechwan, were infested with *Enterobius vermicularis*. *Ascaris lumbricoides* has been found to be very widely distributed in Szechwan, with an incidence of 84·5–95·5 per cent. The average worm-burden is 8–50 worms, but some children may harbour 100–150 Ascarids. The fertilization of crops grown near houses with night soil is regarded as the most important epidemiological factor; less significant are the eating of raw or partly cooked vegetables and promiscuous defæcation. Under urban conditions pickled vegetables can transmit the infestation. Ascaris eggs were found to complete their embryonation after 60 days immersion in wine, vinegar, sauces, etc.

Finally, the Indian rat-flea, *Xenopsylla cheopis*, which is the principal vector of plague, has been found to be very common in Chengtu, Szechwan. The public health importance of flies is being studied and also the parasites of dogs, cats and other domestic animals.

It is evident that parasitologists of Free China are doing admirable work under very difficult conditions. The sympathy of everyone will go out to them, and practical help should be given from every quarter possible. There must be excellent candidates among them for the postgraduate training established at Cheloo University and the National Kiangsu Medical College. G. LAPAGE.

THE ROYAL OBSERVATORY, GREENWICH

ANNUAL REPORT

THE Annual Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, deals with the period May 1, 1942–April 30, 1943. Astronomical work at Greenwich has been confined to observations recently re-started on the Airy transit circle, the normal solar work on the photoheliograph and spectrohelioscope, and some special observations of the partial solar eclipse of September 10, 1942, and of certain lunar occultations. The time service, as in the previous year, has been shared between two out-stations, the locations of which are not disclosed. Routine meteorological observations are still made at Greenwich, and the magnetic work continues at Abinger. The Chronometer Depot and the Nautical Almanac Office are also operating away from Greenwich.

Echoes of the War can be detected even in such a report as this. The Nautical Almanac Office has been engaged on computations for the Service Departments to such an extent that astronomical work has been restricted to the minimum required for the continuance of the various almanacs. It needs little imagination to see why work has been recommenced on the "Astronomical Navigation Tables", which are being extended up to 79° N.; while as the result of an extended visit from staff of the Director of Navigational Training (Air Ministry), modifications are to be incorporated in the "Air Almanac" which should make it even more useful to the practical navigator. New editions of the Admiralty magnetic charts have been published, and an analysis of the residuals between observed and computed values of th various data has been undertaken to obtain information about the regions where the chart values ar most uncertain. In the polar areas, where observations are few but where information is needed in war-time, the computed values are used as a guid in drawing the isomagnetic lines. Growing recognition of a close correspondence between solar activity and radio communication is emphasized by the establishment of liaison between the Observatory and certain radio organizations. The estimated times of central meridian passage of large sunspot are now telephoned, for example, to the Radio Research Station of the National Physical Laboratory to the British Broadcasting Corporation, and t Cable and Wireless, Ltd.

It is perhaps in the section dealing with the time service that the matter of greatest general interest i to be found; here certainly the biggest changes ar forecast. It is clear from this report that the Tim Department of the Observatory, partly as a result of increased demands from radio communication services, partly from other war-time needs, is in proces of drastic modification and extension. Experienc with the dual system of operation mentioned above has clearly demonstrated the desirability of providing for two stations as a permanent measure. A Post Office line giving direct communication between the stations for 57 minutes in each hour is now available and greatly facilitates the combination of data. Short-wave signals are now radiated simultaneously with the long-wave rhythmic signals from *GBR*, and of course the 'six dots' service to the B.B.C and the control of the Post Office 'talking clock continue. A modification in the signal transmission procedure has been introduced for the purposes o frequency checking: the rate of the precision signal is now kept as near zero as possible. Should subsequent data show that a signal already emitted is in error (perhaps as the result of a long extrapolation), the correction will be made not gradually but in a jump, the signals then continuing with a zero rate a nearly as possible.

Two fundamental changes in the control of the time service are forecast in the report. The first concern the standard clocks. As has been shown elsewhere (*Mon. Not. Roy. Astro. Soc.*, **103**, 196; 1943), quartz crystal clocks are affected by short-period erratic much less seriously than are pendulum clocks. The occurrence of continual unpredictable changes of rate which, when integrated, produce disturbingly large 'wandering' in pendulum clocks can be greatly reduced by the use of quartz clocks. Prediction of clock error in cloudy weather can thus be made much more certain than it is at present, and it is already the practice to base the time service fundamentally on quartz clocks now established at other institutions, and to use the Observatory pendulum clocks as sub-standards. The report states: "The presen standard of accuracy calls for the elimination o existing pendulum clocks from the operation of the time service at the earliest possible moment". The second change concerns the observational control o the standard clocks: the Astronomer Royal forecasts the supersession of visual time observations on the present standard type of transit instrument. I is believed that a photographic telescope, perhaps o the zenith tube type, should be less liable to accidental errors, and possibly also to systematic errors than the visual instrument.

It is evident that the present trend on the time keeping side of the service is towards electronic rather than electro-mechanical equipment; and on the observational side towards the impersonal photographic plate rather than the over-fallible human senses. As always, the attainment of extreme precision is costing much effort; and if there exists any fleeting regret at the passing of the pendulum, which has served us well for nearly three centuries, it should be allayed by increasing confidence in the last decimal place of the published time-signal corrections.

WAVE GUIDES IN ELECTRICAL COMMUNICATION

AT a meeting of the Wireless Section of the Institution of Electrical Engineers on November 3, a paper was presented by J. Kemp under the title "Wave Guides in Electrical Communication"; this having been published prior to the meeting (*J. Inst. Elec. Eng.*, **90**, Part 3, No. 11; September 1943). With the continuous extension of radio research and application to increasingly higher frequencies, the electrical engineer is already making considerable use of wave guides in place of the more conventional pair of wires or a co-axial cable. The paper under consideration comprises a most valuable survey of the state of published knowledge on this subject and a good introduction for those who have to become familiar with this new technique in the immediate future.

The fundamental theoretical principles of the propagation of electric waves inside hollow conductors or 'guides' have been known for nearly half a century, as a result of the investigations of Sir J. J. Thomson, Sir Joseph Larmor and particularly of Lord Rayleigh, who, in 1897, first dealt with the subject in a comprehensive manner, and established the foundations of the theory on which the modern structure rests. Although Lord Rayleigh's investigations were restricted to hollow metal tubes of infinite conductivity, of unlimited length and of arbitrary cross-section, he was able to show that two distinct classes of waves could be propagated down such a tube. These waves are distinguished by the fact that, in addition to the transverse electric and magnetic forces which accompany the transmission of waves along two parallel wires or a co-axial cable, there is a resultant longitudinal force, which is electric in one case (E-class wave) and magnetic in the other case (H-class wave). Corresponding to the various modes of vibration of a circular membrane or of liquid in a cylindrical vessel, each of the above two classes of wave can be propagated in wave guides in various modes and orders, the essential features of which are described and illustrated in Mr. Kemp's paper.

Up to about 1930, the further investigation of the 'guiding' action of conductors on electric waves was largely confined to the study of transmission line technique or of the propagation of waves round the surface of the earth. Owing to the fact, shown by Lord Rayleigh, that wave-guide transmission could only take place when the wave-length was of the same order or less than the cross-sectional dimensions of the tube, the practical development of the subject had to await the availability of means for the production of very short waves. The paper under consideration shows that, during the past eight years or so, much of the experimental investigation and development of wave-guide technique has been carried out in the United States, notably by G. C. Southworth, S. A. Schelkunoff, W. L. Barrow and their co-workers. All this and other work are summarized in an admirable manner in Mr. Kemp's paper, which describes and illustrates the way in which the various types of waves may be launched into guides, the attenuation and other conditions to which they are subject, and the means whereby they may be converted from one type to another, or may be amplified, detected and received for practical use. In addition, by providing suitably spaced apertures in a wave guide, or by terminating it in a flared horn of suitable size and shape, the wave energy propagated along the guide may be radiated into free space in the form of a concentrated or widespread beam analogous to the emission of longer waves from antenna arrays and reflector systems. Conversely, such horns may be used to receive incoming radiation and feed it into a suitable wave-guide on its way to the radio receiver.

As the author of the paper under consideration points out, the prospective field of application of wave guides embraces various systems of communication, providing telephone and television channels in numbers vastly exceeding those of any system of established type. When used in conjunction with horns, the guides may serve for broadcasting and television, for blind landing of aircraft, for detecting, locating and manœuvring of ships, and for other purposes such as radio telephone links, for which at present radiators and receivers of conventional type are used. The full extent of the field of application of wave guides will ultimately be governed by economic as well as technical considerations, and must therefore remain largely a matter of conjecture; but, judged from the course the development has taken during recent years, it is likely that the field will be large and attractive.

ARCHÆOLOGICAL EXCAVATION IN KASHMIR

DR. HELLMUT DE TERRA has issued an account of his investigations of the megaliths of Bursahom, Kashmir (*Proc. Amer. Phil. Soc.*, **85**, No. 5; September 1942). The valley of Kashmir has been, of course, of the greatest importance in Indian prehistory. It has been a channel through which cultures have penetrated southwards from west-central Asia on one hand and from the Tarim basin on the other. When the early Indus civilization, about which something is now known, thanks to the excavations at Mohenjo Daro, etc., began to wane, cultures from the far north gradually penetrated into northern India, and Kashmir was one of the routes taken by the immigrants. It is to be expected, then, that any early finds in Kashmir might well show foreign influences.

Bursahom is situated on a hilltop composed of pleistocene material, and near by is a megalithic monument recalling in shape a cromlech. Excavation revealed three layers. The uppermost yielded sherds belonging to the Buddhist period of the later Indo-Scythian dynasty of the fourth century. The second cultural level yielded hearths, loose stone foundations and five pits with urns containing the bones of pig and deer. Black burnished ware, decorated with incised geometric ornamentation, occurs. It is suggested that this culture shows influences from north-west or west-central Asia, and that the megaliths probably belong to this period. The oldest culture level yielded hand-made pottery with "textile-and-matt" design, as well as polished celts and bone tools. The pottery shows affinities with that known from Kansu and Turkestan; it suggests an Early Metal Age culture comparable with the Manchang ware culture of Kansu.

Unfortunately, owing to the outbreak of the War and the fact that the finds had to be left at Srinagar, Dr. de Terra has had to depend on photographs and field notes for the description of the objects. But the article is of great interest, and the author is to be congratulated on having found time from his main pleistocene research in northern India to deal with a small but none the less important archæological investigation. M. C. B.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Saturday, December 11

British Mycological Society (at the Linnean Society, Burlington House, Piccadilly, London, W.1), at 2 p.m.—Dr. S. P. Wiltshire: "The Organization of the Study of Systematic Mycology".

Monday, December 13

Royal Geographical Society (at Kensington Gore, London, S.W.7), at 3 p.m.—Dr. Rudolf Bićanić: "Effects of War on Rural Yugoslavia".

Institute of Fuel (at the Central Station Hotel, Newcastle-upon-Tyne), at 5.15 p.m.—Dr. A. Parker: "The Work of the Fuel Research Board—its Achievements and Objects".

Tuesday, December 14

Royal Society of Arts (Dominions and Colonies Section), (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. G. Martin: "Competitive Rubber Plants".

Chadwick Public Lecture (at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London, W.1), at 2.30 p.m.—Air-Commodore P. C. Livingston: "The Maintenance of Visual Efficiency in the Royal Air Force".*

Institution of Chemical Engineers (joint meeting with the Chemical Engineering Group and the Institute of Petroleum) (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Mr. J. G. C. Boot: "Petroleum as a Base Material for Chemical Industry".

Eugenics Society (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Dr. J. A. Fraser Roberts: "Population Problems in the Light of Differential Fertility".

Institution of Civil Engineers (Road Engineering Division) (at Great George Street, Westminster, London, S.W.1), at 5 p.m.—Lieut.-Colonel S. A. McMillion: "The Alcan Highway".

Royal Institution (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. J. C. Drummond: "Food Problems of the Post-War Years", 4: "Food Education".*

Wednesday, December 15

Royal Society of Medicine (Section of Comparative Medicine) (at 1 Wimpole Street, London, W.1), at 2 p.m.—"The Limitations and Uses of the Comparative Method in Medicine", 2: "Animal Ecology and Genetics" (to be opened by Mr. M. A. C. Hinton, F.R.S. (Ecology), and Dr. H. Grüneberg (Genetics)).

Thursday, December 16

Royal Institution (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Prof. W. Perceval Yetts: "Links between Ancient China and the West—a Study of Exchanges in Material Culture", 4: "Northern Nomads as Agents".*

London Mathematical Society (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Dr. B. Segre: "Arithmetic upon an Algebraic Surface".

Royal Society (at Burlington House, Piccadilly, London, W.1), at 4.15 p.m.—The Rt. Hon. Lord Rayleigh, F.R.S.: "Pebbles, Natural and Artificial—their Shape under Various Conditions of Abrasion"; Mr. S. L. Smith and Mr. W. A. Wood: "Internal Stress Created by Plastic Flow in Mild Steel, and Stress-Strain Curves for the Atomic Lattice of Higher Carbon Steels".

Friday, December 17

Physical Society (in the Physics Department of the Imperial College, Imperial Institute Road, South Kensington, London, S.W.7), at 4.30 p.m.—Presentation of the twentieth Duddell Medal to Mr. John Guild. Demonstrations.

Royal Institution (at 21 Albemarle Street, London, W.1), at 5 p.m.—Mr. Philip Guedalla: "The Evolution of Air Power".

Institution of Mechanical Engineers (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Mr. N. R. Neal: "Application of Statistical Methods to the Control of Industrial Costs"; Mr. J. C. Edwards and Mr. W. A. Bennett: "Inspection Efficiency"; Mr. A. W. Swan: "Sampling Schemes for Accept-Reject Inspection".

Saturday, December 18

Institute of Physics (Electronics Group) (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. L. Jánossy: "Cosmic Rays".

Royal Photographic Society (Scientific and Technical Group) (joint meeting with the Association for Scientific Photography) (at 16 Prince's Gate, South Kensington, London, S.W.7), at 2.30 p.m.—Exhibition of Scientific Photographic Apparatus.

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Second Technical Assistant (temporary) in the Agricultural Economics Department—The Secretary, Edinburgh and East of Scotland College of Agriculture, 13 George Street, Edinburgh (December 14).

Fieldman to assist the Advisory Chemist—The Registrar, The University, Leeds 2. (December 14).

Assistant Master to take Machine Drawing and Design, and Mathematics to Senior National Certificate standard, and Practical Machine Shop Work in the Junior Technical School—The Principal, Wolverton Technical College, Wolverton, Bucks. (December 17).

Assistant Master or Mistress to teach Mathematics and Practical Geometry at the Willesden Technical College, Denzil Road, London, N.W.10 (Junior Technical School of Building)—Dr. E. Davies, Education Offices, Vernon House, 163 Willesden Lane, London, N.W.6 (December 18).

Junior Scientific Officer in the X-Ray and Radium Departments at St. Bartholomew's Hospital—The Clerk to the Governors, St. Bartholomew's Hospital, London, E.C.1 (December 18).

Science Master, mainly for Chemistry, up to University Scholarship standard, at the City of London School—The Town Clerk, 55–61 Moorgate, London, E.C.2 (January 12).

Chair of Chemistry—The Principal, University College of Wales, Aberystwyth (January 15).

Regius Professor of Zoology at Glasgow University—The Private Secretary, Scottish Office, Fielden House, 10 Great College Street, London, S.W.1 (January 17).

Assistant Lecturer for Science and Mathematics (and, if possible, some Physical Training)—The Principal, County Technical School, Halesowen, Worcestershire.

Assistant Master (graduate) for Mathematics, Science and Drawing, at the Aston-under-Lyne Junior Technical School for Boys—The Director of Education, 8 Warrington Street, Ashton-under-Lyne, Lancs.

Technical Assistant and Laboratory Steward for the Department of Botany—The Bursar, University College of North Wales, Bangor.

Laboratory Assistant for the Physics Department—The Principal, Chelsea Polytechnic, Manresa Road, London, S.W.3.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Essential Principles for the Reconstruction of Post-War Education. A Memorandum by the National Association of Inspectors of Schools and Educational Organisers. Pp. 8. (Upper Largo: National Association of Inspectors of Schools and Educational Organisers.) 3*d*. [211

University of London: University College. Calendar, Session 1943–1944. Pp. 134+xxv. (London: Taylor and Francis, Ltd.) [411

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol. 27, 1942. Pp. 546. (London: Society of Chemical Industry.) [511

Other Countries

U.S. Office of Education: Federal Security Agency. Bulletin 1942, No. 3: Accredited Secondary Schools in the United States. (Supplement to Bulletin 1939, No. 2.) Pp. ii+56. (Washington, D.C.: Government Printing Office.) 10 cents. [249

Lucknow University Studies. No. 15: Recent Advances in Galactic Dynamics. By Prof. A. C. Banerji. Pp. vi+116. (Lucknow: Lucknow University.) [279

Nigeria. Annual Report on Forest Administration for the Year 1942. Pp. 22. (Ibadan: Forest Department.) [289

University of Bombay: Department of Chemical Technology. Prospectus 1943. Pp. v+77. (Bombay: University of Bombay.) [309

U.S. Office of Education: Federal Security Agency. Bulletin 1942, No. 2: Arts, Crafts and Customs of our Neighbor Republics: a Bibliography. Compiled by Emilie Sandsten Lassalle. Pp. 52. 10 cents. Leaflet No. 65: Inter-American Education Demonstration Centers; Report of Project, January to June 1942. By Helen K. Mackintosh, assisted by Juanita MacDougald Melchior. Pp. iv+24. 10 cents. (Washington, D.C.: Government Printing Office.)

U.S. Department of Agriculture. Technical Bulletin No. 850: Studies on Host Plants of the Leafhoppers of the Genus Empoasca. By F. W. Poos and Nancy H. Wheeler. Pp. 52. (Washington, D.C.: Government Printing Office.) [110

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 23, No. 35: Mammals of the Clearwater Mountains, Idaho. By Robert T. Orr. Pp. 511–536+plates 45–47. Vol. 23, No. 36: Mollusks of the Clearwater Mountains, Idaho. By Allyn G. Smith. Pp. 537–554+plate 48. (San Francisco: California Academy of Sciences.) [110

Catalogue

A Catalogue of Books on a Variety of Subjects suitable for presentation together with a selection of New and Recent Books. (No. 615.) Pp. 24. (London: Bernard Quaritch, Ltd.) 1*d*.

University College of Science.
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NATURE

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THE HOUSING OF SCIENTIFIC SOCIETIES

AT a time when plans of reconstruction are being everywhere projected, it was fitting that Sir Henry Dale, in his presidential address to the Royal Society (see NATURE, December 4, p. 649), should put in a claim for more adequate and dignified accommodation for science. Men of science do not require to be told how meanly housed are many of the scientific societies in Great Britain; they can be forgiven a feeling of envy towards their colleagues in other lands where science has been made to enjoy an honoured place in the scheme of national life. It is pertinent to inquire why this should be. We believe that the real root of the matter is that false philosophy which refuses to regard science as a normal way of life in a modern community. To say this does not mean that we claim priority treatment for science; we demand no more than a recognition of the debt which any modern State owes to scientific endeavour.

That this debt is not admitted and honoured may be partly the fault of scientific men themselves. They have sometimes been too prone to seek refuge in a sort of splendid intellectual isolation; they have neglected—some would assert wilfully—the methods of advertisement which art and the drama, music and literature, have employed to stake their claims in the life of the modern State. Speaking a language which is not always understood by ordinary people, they have suffered from being misunderstood; and such a state of affairs is made the easier when the machinery of government and the organs of public opinion—the Press and radio—are guided by men who have too frequently been denied a scientific background to their education.

In general terms, Sir Henry Dale gave some indication of the debt which Great Britain owes to science in war. The Press at once seized upon his words, that to-day the United Nations are superior to their enemies in scientific achievement; the man-in-the-street, had he not read those words, would have been the first generously to recognize that science in war has given life and property a greater protection than was known when enemy bombers raided his towns and cities nightly. At some other time, no doubt, Sir Henry Dale will tell our people how much greater can be the achievements of science in peace, and particularly in those vital years which will follow victory, when great works of reconstruction will have to be carried out on a world-wide basis. Such a pronouncement will hearten all those who have faith in the future.

But the efforts of scientific men to assist in the fabrication of a better world merit a frank admission of the claim for better accommodation for the scientific societies. These societies were founded to enable men of science to meet together to discuss common problems, and the part which they have played in the advancement and dissemination of scientific knowledge is incalculable. The State recognized the importance of the societies in 1778 when it granted the Royal Society accommodation in Somerset House; and Sir Joseph Banks, in his presidential address of 1780, boldly declared that the Society's new home was a "generous recognition by the sovereign of the services which science had rendered to the state". Later, the State admitted the claims of some of the younger societies for accommodation, and still remains in the status of their landlord. We can deplore the lost opportunities of the middle years of the last century, when for a moment it seemed as though London was to be ennobled by a great centre for science. That was one of the grand visions of the Prince Consort; and none was more eager to clothe it with reality than Sir Charles Barry, the architect. The latter's scheme, propounded in 1859, for the development of the Burlington House site, indicates how much London lost by its rejection by the Government of the day. Science lost too; but it is very doubtful whether even Barry's scheme, designed as it was in the grand manner, would have met present-day needs. No one then suspected that the Chemical Society would increase its membership from about 500 to 5,000: as Sir Henry Dale observed, no one then suspected even a future for physics! Increase in membership and better facilities for publication have resulted in an expansion of libraries which was unthought of in the days when the societies moved into Burlington House.

What is the solution? In the first place, the State must be made to appreciate that science has a right to adequate and dignified accommodation in the metropolis. We can but reiterate the words of Sir Henry Dale. "I do not think that we must stand by and allow the claims of science again to go by default. A fear of overstatement, a passion for critical accuracy which is part of the very spirit of science, may make us reluctant advocates. If necessary, however, we must be ready to remind all who may be concerned of the part which the British scientific effort has played in making it possible now to plan at all, with confidence, for our own civic and national reconstruction. But for science, we may remind them, the very different plans which our enemies were so recently making for our future might already be taking effect".

Sir Henry is right in thinking that the claim will, no doubt, be frankly acknowledged: it will certainly be by the ordinary man, but only when he is educated to know more about the nature of the claim. That this can be done has been abundantly proved in the U.S.S.R., where science has a real 'news value' in the Press and over the radio: it is an experiment which might properly engage the attention of scientific men in Great Britain. The scientific societies would not fail to benefit from it.

In the second place, any scheme for the rehousing of the scientific societies must leave room for expansion. The experience of the past has shown us that adequate accommodation to-day becomes inadequate accommodation to-morrow. No doubt a certain amount of rationalization can be effected, for example, in libraries and publication activities, thereby preserving a proper economy of space. But what is imperative is that the State shall immediately tackle this pressing problem. Again to quote Sir Henry Dale: "I think that we have the further right to expect that the home of science, in this capital city, will have a dignity symbolizing its value to the nation and empire, and enabling us to hold up our heads in the company of other countries, whose scientific academies, not more famous than ours, have so long been housed more worthily, and with a more generous recognition of their due place in an enlightened people's scale of cultural values". These are words which ought to be pondered by those who are now engaged in framing a policy of replanning for London.

THE BRITISH SCIENTIFIC INSTRUMENT INDUSTRY

ONE of the immediate results of the harnessing of the whole of the man-power of Great Britain to the war effort has been to engender an almost universal appreciation of the vital part played by scientific instruments in a nation's life. No longer is the scientific instrument an obscure device to be used only by the expert and to be understood only by the specialist. Rather, to the men and women of the factories and of the Fighting Services, it has become a familiar and essential tool, the use of which makes them masters of complicated mechanisms and processes and enables them to achieve, both in the workshop and in combat, a most satisfying degree of precision. The nation has, in fact, become instrument-minded, and this should hearten those who, by the written and the spoken word, have in recent times pleaded for a more vigorous application of science to our national life. For the scientific instrument is one of the main vehicles by means of which the fruits of science are made available to the ordinary citizen, and the general public has, as never before, first-hand evidence of the value of the application of science as it appears concretely embodied in the scientific instrument of daily war-time use.

The circumstances and conditions of the War should have compelled the nation to make the maximum use of its scientific knowledge and of its scientific personnel, and it is not surprising that a belief should have become general that they could be employed equally advantageously when the nation is confronted with its post-war problems even if the nature of these can only be conjectured. In consequence, reports have been prepared dealing with improvements in scientific education, with the provision of the right type of technical personnel for industry, with the necessity of increasing the scale of both academic and industrial research, and with many allied subjects. A point to be observed is that if the high hopes entertained of the adequate use of scientific knowledge in the future are to be realized if research activities are to be markedly increased if the scientific control of industrial processes is to be fully developed, and if scientific education is to be modified so as to provide an effective channel for the infiltration of scientific knowledge into the national life, an adequate supply of scientific instruments suited to each and every purpose, must be available ıe scientific instrument industry should be so proessive in spirit and so efficient in technique as to able not only to meet these potential heavier mands, but also to develop and to produce new pes of instruments incorporating in their design d principles of operation any new phase of scientific owledge of practical application. The moment is erefore opportune to review and to take stock of e scientific instrument industry in Great Britain, d an immediate occasion is provided by the issue a handbook of the Scientific Instrument Manufacrers' Association of Great Britain, Ltd.

It is instructive to be reminded that the early ientific men were their own instrument makers, and at in the seventeenth and eighteenth centuries the storic names of science were associated with instruent invention and production. Many of Sir Isaac wton's investigations were carried out with instruents made with his own hands; the same may be id of Robert Hooke and later of Sir William rschel. It was in these early days of modern perimental science that the origins of the British entific instrument industry are to be found. strument-making firms were established in Newn's time and at an even earlier date, two, at least, which survive to this day. As Mr. R. S. Whipple ints out in an interesting article in the handbook, e increase in the numbers of workers in the scientific ld created a demand for skilled and professional strument makers, but even up to very recent times e experimental scientist evinced a keen interest instrument design and development. One need ly mention the instruments associated with the me of Lord Kelvin and the existence of instrument ms the boards of which, a generation ago, were mposed almost completely of men of professorial nding. New advances in scientific knowledge quently lead to the eventual creation of new types instruments, and one obvious advantage of the se association of the scientific man with the prosional instrument maker lies in the probability at by it the implications of a scientific discovery the field of development will not be ignored for unnecessarily long period. It is perhaps unfornate that in recent years the links between the entific worker and the instrument maker have, in eat Britain, become weaker; in some countries ey have been strengthened. The reputation of itish scientific instruments was never greater than en the great names of science were linked with entific instruments, and the prestige given to the lustry by that association still remains a lively asset.

The pioneer work of British instrument makers ould not be forgotten and can be remembered with ich satisfaction. The science of surveying owes ich to Jesse Ramsden and to William Simms, and at of photography to Andrew Ross and to Dennis ylor. A notable contribution has been made to e development of the microscope and telescope, ile in the science of electrical measurements the mes of Faraday, Maxwell, Wheatstone and Kelvin ll be for ever remembered. Moreover, this pioneer rk was accomplished in the high days of craftsnship, and among the traditions with which a long and honourable past has endowed British instrument manufacturers, none is of greater worth than that of the highest standard of workmanship. While it is true that the quickened tempo of modern industrial life no longer permits the use of methods by which each individual instrument becomes a monument to the craftsmanship of the worker, there yet remains in the manufacture of instruments of precision ample scope for the display of workmanship of the highest quality. During this War, the Services owe much to the compelling force of conservative tradition which has not allowed workmanship in the instrument industry to fall a victim to the claims of production, but has insisted that instruments shall have that distinctive quality which craftsmanship alone can give and that standard of performance so essential in creating confidence in the mind of the user.

The achievements of the industry during the War are too obvious to require enumeration. As has been remarked, there exists a common knowledge of the importance and ubiquity of scientific instruments in both the industrial and the combatant spheres, and the scale of production of instruments is well appreciated. It is a truism that 'instruments are the eyes and the ears of ships and aircraft and the nerve centres of armies and navies in attack and defence'. A special word should, however, be said of the work of the optical instrument industry. The manufacturers of optical instruments are in the unfortunate position of producing goods which are in no sense perishable. The equipment of a laboratory with, say, microscopes, serves not for one, two or even five years, but for a generation. The elderly Service officer even now boasts that his prismatic binoculars served him well throughout the War of 1914–18 and are rendering excellent service in the present one. The size of the optical instrument industry can never be commensurate with the importance of its products, and yet in war-time the demands made on the industry are insatiable. The proportionate minimum requirement for skilled workmen and craftsmen is probably higher in the optical instrument industry than in any other, but in war-time man-power boards are apt in this respect to regard any minimum as largely excessive. In spite of its original limited capacity and of the large dilution of its skill with inexperience, the optical instrument industry in Great Britain has successfully met the demands which have been made upon it, and has done so while still retaining to a very large degree its traditional insistence on good craftsmanship and high instrumental performance. Notwithstanding its inflation, the industry has not lacked adequate British supplies of the various types of optical glass, the quality of which has not been excelled anywhere or at any time. It is appropriate here to pay a tribute to the work of the Inter-departmental Scientific and Technical Committee on Optical Glass and to the wise planning which inaugurated that Committee.

The future of the scientific instrument industry in Great Britain cannot be considered without reference to the closing period of the War of 1914-18. It is generally believed, and hoped, that the circumstances and conditions of the latter half of the year 1918 are reappearing. The immediate future will show whether this be true in the military sphere, but it is certain there was then, as now, a 'stirring of the waters' in regard to the urgency of a greater application to industry of science and its principles, and the same realization of the dependence of such application on an adequate supply and use of scientific instruments. It was at that time that the research association movement of the Department of Scientific and Industrial Research came into being, and the British Scientific Instrument Research Association was formed in that year. Then, as now, an expanded and efficient scientific instrument industry had arisen which had met all the demands of war and seemed capable of satisfying all requirements of the post-war future. It is now a matter of history that the response of industry in general to the opportunity presented by the Government's sponsorship of research was only half-hearted. The instrument industry, and in particular the optical instrument industry, dwindled to its pre-war level, and, more lamentable still, much of the new skilled labour which had been developed within the industry was irretrievably lost.

Into the special conditions, which it is fervently to be hoped will not re-occur, and which resulted in the years following the war being particularly lean ones for the instrument industry, it is not proposed to enter here, nor is it appropriate to consider the measures, involving high policy, which might be taken to prevent their recurrence. Rather will it be assumed that the immediate future will witness a marked evolution in scientific education and a revival of intense research and development activity in industry. In the Report of the Committee of the Privy Council for Scientific and Industrial Research, 1927–28, the following statement occurred: "The British Scientific Instrument Industry occupies a peculiar position. Its direct economic importance is small, but its indirect value is out of all proportion to its size. We shall not be far wrong now in regarding the sales of scientific instruments as a measure of the health of our chief manufacturing industries." This statement is obviously true, although the words "and of scientific progress and education" might well be added to it. The responsibility of the scientific instrument industry to industry in general is apparent and, of all industries, it should be research- and development-minded. Since 1918 the industry has maintained, with assistance on generous terms from the Department of Scientific and Industrial Research, its Research Association, albeit on a modest scale. The Research Association has carried out both basic and immediate investigations into the problems of manufacture of instruments and of the processes employed in manufacture, the results of which have been of great benefit to the industry, and the full fruits of which have been realized during the War.

There is a feeling within the industry, however, that it should maintain a research association which would operate on a scale, not determined by the limited resources of the industry in the past, but rather by the position of high responsibility of the industry. The basic research of such a research association would provide the material on which the developme departments of individual firms would build, to t benefit both of the manufacturing industries and education. It must be remarked, however, that t Services, industry and education each has a respc sibility towards the scientific instrument indust Nothing could be more helpful to the instrume industry than insistent demands made upon it fr outside. These demands should include the pro sion of all types of instruments, adequately to eq British industry with the scientific tools of cont and research, and to give to scientific education added practical value which will ensure that suita trained personnel is available for applied scien Insistence should also be made on the early devel ment within the industry of special instruments special purposes, and of new types of instruments, allow of full advantage being taken of new advan in scientific knowledge.

The handbook issued by the Scientific Instrum Manufacturers' Association shows that the wh range of scientific instruments is covered by industry. The long and distinguished history the industry provides a strong foundation for hope that it will serve the generations of the n era well, and the achievements of the industry in War give an earnest that it can meet the most insist demands made upon it. The future prosperity of nation demands that it shall, in fact, so do.

INITIATION INTO MODERN LOGIC

A Modern Elementary Logic

By Prof. L. Susan Stebbing. Pp. viii+214. (Londc Methuen and Co. Ltd., 1943.) 8*s*. 6*d*.

THE author's aim was to provide a text-bc primarily for first-year students reading lo at the universities. But the reason for that in content and emphasis of her book which differentia it from the usual manuals, and to which the appe tion of modern in its title directs attention, may be immediately apparent to one unacquainted w the change of orientation and the nature of work resulting therefrom which mark the advan ment of the subject since the earliest years of t century.

The source of the difference may be indica very summarily in this way. The scope, purp and content of the discipline traditionally associa with the names of Aristotle and Mill were determi in the main by the conception of logic as bein study of thinking (that is, of judging and inferri or an analysis and criticism of thought, princip concerned to elicit the principles by which vali was secured for those processes. In contrast w this view, contemporary formal or mathemat logicians set aside the thinker and his thinking irrelevant, substituting as the proper 'data' of lo the field of all possible propositions and the relati connecting them. Much as the geometer is said to t for his subject-matter lines, planes, solids, their vari characters and relationships, and not his think about these, so the logician is invited to regar his proper subject-matter propositions and t relations one to another, in abstraction from dging about them or inferring from them. In is way, logic no more than geometry is to be a dy of thinking, and pure mathematics comes to represented as simply an extension or development pure or formal logic. Now this newer orientation d the novel distinctions and analyses traceable to have as yet penetrated scarcely at all into university ching and text-books of elementary logic, and by mposing this "Modern Elementary Logic" Prof. ebbing sought to amend present practice and secure at the new orientation shall be dominant in the st-year course.

Only an experienced and clear-headed teacher ssessed of her mastery of the new work could ve composed within so limited a space an exposition solidly informed and lucidly expressed of the more ndamental parts of the new discipline. All in the ok is admirable that appertains to precision of tement, to relevance and to the order in which e various topics are introduced. But these excel- cies are compromised by two defects in particular, d they are scarcely trivial ones. In the first place, ere is a lack of uniformity in the presentation, nsequent upon the author changing the viewpoint m which she treats her material. Though she heres for the most part to the 'modern' viewpoint hich substitutes proposition for process), she some- nes forsakes it and adopts the 'traditional' one. e objection here is not, of course, that some of e *matters* treated in her book (for example, variations mental attitude in judging; syllogistic reasoning) long to the body of traditional logic. It is that ey are treated in the same *manner* as that in which ditional logic treats them: that is, in a manner ich presupposes the 'traditional' point of view and t the 'modern' one. Consequently we find, not one de of treatment consistently pursued from first last, but two unharmonized modes of treatment; reatment from one viewpoint of certain matters hich have also been traditionally expounded), and treatment from a different viewpoint of other tters (some of which were not expounded in ditional logic). That is to say, she passes from a int of view which presupposes as 'data' nothing t propositions and their relations, to the other int of view which presupposes thinkers and their ntal activities of judging and inferring. To ask ether this inconstancy is symptomatic of anything founder than a blemish in the logical purity of exposition or statement would be to raise a ge issue in epistemology. But it does affect the ok's claim to being 'modern' in the special sense licated, though it will cause no embarrassment to first-year student, nor, provided his examiners 'modern-minded', will it diminish the book's use- ness in preparing him for examination.

This last, however, can scarcely be affirmed of the ond defect to be mentioned; namely, the very dequate space accorded to induction and method- gy. All that the author has to say on this extensive anch of logic is packed into twenty pages, or one nth of the whole book. She admits that her readers ll have to "consult other textbooks" about the tail of induction and methodology. But should t a text-book on logic "intended for first-year dents" comprehend all that is essential for the st-year examination? It is no solution to crush e exposition and illustration of matters that make so much as half the student's whole syllabus into e brief final chapter, and then refer him to other rces for what is wanting. This unwarranted curtailment is regrettable for the further reason that it may only too easily give the beginner the false impression that logic is almost wholly occupied with the demonstrable and certain, and scarcely at all, save in a quite secondary way, with the problematic and its criteria. One inclines to suppose that it is the author's lively interest in mathematical logic that led her to devote so inordinate a proportion of her space to formal doctrine, otherwise the room taken up in expounding a number of technical distinctions that are of no vital concern to a beginner (for example, that between 'entailment' and 'material implication') would have been used to discuss and illustrate more fully what is unquestionably of far greater importance to him.

To sum up: taking the chapters one by one, each certainly succeeds in conveying a great deal of information in short compass and without congestion. But taken collectively, those chapters make up an ill-balanced book. Specialist enthusiasm seems to have been responsible for injudicious selection. However important a contribution to one special department of the subject these Russellian developments may be, it seems undesirable to incorporate them so immoderately in a first-year text-book that they form the bulk of the logic with which the beginner first becomes acquainted.

S. V. KEELING.

ROLE OF VITAMINS IN PLANT PHYSIOLOGY

Plants and Vitamins

By W. H. Schopfer. (A New Series of Plant Science Books, Vol. 11.) Pp. xiv+300. (Waltham, Mass.: Chronica Botanica Company; London: Wm. Dawson and Sons, Ltd., 1943.) 4.75 dollars.

FEW studies in biochemistry have aroused such popular interest as the remarkable advances made in recent years concerning the dependence of animals on small doses of those substances, produced mainly by plants, which we call the vitamins. It is natural that the marked heterotrophy for these substances in man has stimulated interest largely in the vitamin aspects of animal nutrition; but it has always seemed anomalous that the importance of vitamins to the plant which makes them, realized only vaguely even by many botanists, has not had wider publication. This gap has now been filled in this remarkable book, and it is well that the first major review should come from the hands of an expert, and indeed one who may be said to be the founder of the modern science of plant vitaminology. His book is, as it must be, of the nature of a preliminary report on a subject now in the full tide of development; but it tells, in an orderly way, of all the important advances made in the ten years since Schopfer (1934) first showed the necessity for vitamins in the culture of Phycomyces, with sufficient bibliography to enable enthusiasts to find other sources of information. It is further very satisfactory that the author, though not hesitating to reproduce and discuss the structural formulæ of the vitamins and to emphasize the vitally important, if purely chemical, aspects of vitamin structure, does not fall into the trap of making the work biochemical. It is a book written by a plant physiologist for plant physiologists.

Ever since the introduction by Wildiers in 1901 of the concept of bios, plant physiologists have tended to remain aloof, and to explain the apparent necessity for traces of organic growth substances by plants grown in artificial media as due merely to some fault in the composition of the mineral nutrients and organic foods presented to the plants. This is a natural and healthy reaction, and it is clear that some workers on the growth-substance concept have been hasty in their conclusions. Few doubts can remain after reading this book. The author, in the chapter on methods, points out these possibilities of error at some length, and details the many reasons, apart from lack of growth substances, for which a plant will fail to develop on a purely synthetic medium; in fact, he sometimes leans away from the growth-substance concept himself as, for example, on p. 78, where he says of the germination of pollen: "Natural riboflavin is the most active substance on pollen but, since it is contaminated by boron the activity must be attributed to the latter". It is not, of course, clear that all workers adopt the rigorous attitude of Prof. Schopfer, and some of the investigations recorded in this book will scarcely satisfy the reader (for example, the supposed function of asparagine as a cofactor on p. 105), but the careful consideration given to cultural conditions by the author himself leads the reader to accept his opinion with some confidence in most cases.

Experiments have been carried out on very many species at all phylogenetic levels, and in many cases the vitamin requirement worked out in considerable detail by the use of synthetic as well as natural preparations. Auxo-heterotrophy has been demonstrated clearly in many species, among green plants as well as non-green and even in roots of the flowering plant, and is clearly due to a loss of the power to synthesize some essential vitamin. Apart from the very thoroughgoing determination of the necessity for specific vitamins, the author assesses very carefully and logically the bearing of his findings on problems of sexuality in plants, of symbiosis, of parasitism; and many other points of physiological importance are touched upon throughout the book.

The subject naturally divides itself into three subsections, and this division is adopted in the book. Section 1 deals with plants which can synthesize vitamins; Section 2 with plants which cannot; and Section 3 with general physiological problems involving vitamins, of the type mentioned above. In Part 1, after a study of methods, the principal vitamins synthesized by plants are discussed, together with as full an account of their action on plants as present knowledge will allow. In Part 2 follows a detailed discussion of each of the vitamins concerned: thiamin, riboflavin, pyridoxine, nicotinic acid and nicotinamide, ascorbic acid, carotenoids, etc., and their effects on plants which have lost the power of synthesis, as well as a brief excursion into the effects of animal hormones on plants (particularly of œstrone, the only one with any marked effect). The interplay of various growth factors is emphasized in many cases, and special mention may perhaps be made of the useful discussion of the nitrogen-fixing and lactic acid bacteria. The discussion of each vitamin includes the capacity of various plants for synthesis, the specificity of the vitamin and its function in the plant. It is now evident that most, if not all, vitamins operate as coenzymes, or part of coenzyme systems, in the respiratory processes of plants, and this point is well emphasized throughout the book. The third part attempts an analysis of the importance of vitamins in agriculture and horticulture, and a study of parasitism, etc., already mentioned. Lack of precise and wide knowledge makes this the shortest sectio but it is in many ways the most interesting, for shows the way to future fields of great promise. T last chapter is of particular interest to plant physi logists working in related fields, for in it the auth attempts to set up a series of micro-organisms test objects in the study of vitamins.

Apart from a few words of variable spelling (f example, 'thermostabile' and 'thermostable') and o or two sentences the meaning of which is obscure (f example, p. 96, "It is unusual that the fruits riche in carotenoids are frequently the richest in ascorb acid . . .", meaning actually that carotenoids a ascorbic acid are usually associated) the translator to be commended on his performance of a task peculiar difficulty. Prof. Schopfer's book cannot fa to make a wide appeal. His subject is a meeti ground of many specialized sciences—organic chem istry, enzymology, animal and plant physiolog microbiology—and all these meet here to solve pro lems which are fundamental. His book should ther fore be well received as a clear and thoroughgoi exposition of this new field. R. D. PRESTON.

ERATOSTHENIAN AVERAGES

Eratosthenian Averages

By Aurel Wintner. Pp. v+81. (Baltimore, Md.: T Author, Johns Hopkins University, 1943.) 2 dolla

THIS is a curious and interesting little boo though unlikely to appeal to a wide circle mathematicians. The author makes heavy deman both on the intelligence and the knowledge of h readers, and his English, though usually 'correct', English of a very 'continental' type, overpacked wi allusions, parentheses and qualifying clauses. A go deal of allowance must be made for the inhere difficulty of the subject-matter, but it is a pity th he could not write in a simpler and less oracular sty

I will not try to give any reasoned account of t content of the book: a few summary indicatio will be sufficient for any reader sophisticated enou to profit by it. He should be familiar with the ou lines of the classical theory of the distribution primes. He should know the inversion formula Möbius, and the simpler 'Tauberian' theorem 'density' and 'almost periodicity' should mean som thing to him; and he should understand what meant by talking of theorems of different 'depth To such a reader I can commend a book in whi he will find plenty to interest him—theorems new him, and old theorems in unfamiliar settings. If has not this background of knowledge, he would more profitably employed in acquiring it.

The most attractive part is probably Part 2, which the author develops a 'Fourier theory' arithmetical sequences (which includes, for examp the theory of the 'Ramanujan sums'). But sur there should be some reference here to the work Carmichael in Vol. 34 of the London Mathemati Society's *Proceedings*? I should add, in fairness the author, that I have committed the same sin omission myself.

Part 1 (on the 'Eratosthenian matrix') contains interesting discussion of various implications, supposed implications, of the formulæ of Möbi Part 3 (on the 'statistics' of the prime num theorem) is very tough reading, but that is primarily the author's fault. G. H. HARDY.

Microscopic Technique in Biology and Medicine

By Prof. E. V. Cowdry. Pp. iv+206. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1943.) 22*s*.

THIS is decidedly a book for the expert. It consists of an alphabetical arrangement of formulæ, references and short descriptive notes on microtechnical methods, and, as would be expected from its author, it is comprehensive, up to date and well documented. In fact, it is almost too comprehensive, for a number of subjects are included which are only on the fringe of the subject, while on the other hand some of the short articles on methods are so succinct that they suffer somewhat in intelligibility.

The alphabetical method has great advantages in some respects, where such varied material is collected together, but it is rather apt to lead the searcher on a steeplechase across the book when he wishes to get full information on a single subject. Thus "Fixatives", for example, involves sixty-four cross-references. An excellent feature, however, is the printing of all cross references in heavy type, which makes it easy to follow them up.

The first impression on looking into the book is that everything possible is here, but that is going a little too far. The temptation in reviewing such a cyclopædic work is to sigh over the absence of some of the reviewer's own pets, instead of praising the author's actual achievement, but even so, and allowing for the explicit exclusion of plant techniques, it is a pity that there is no mention of Newton's invaluable gentian-iodine technique for chromosomes, and it is surprising that Leishman's blood stain is absent, though it is still widely used.

It would be ungenerous to carp at occasional misspellings and similar trifles, but the reviewer cannot but protest, though humbly, against one more usurpation of the term "Biology" by animal science, in the title of the book. What is wrong with plain "Zoology", when plants are excluded?

Every practising microtechnician will find that this work is one that he will want to keep handy in his work-room. It will be to him of constant and, we hope, of permanent value, not least for the rich store of references it contains.

R. C. McLEAN.

The Diagnosis of Mineral Deficiencies in Plants by Visual Symptoms

A Colour Atlas and Guide. By Dr. T. Wallace. Pp. vi+116+114 plates. (London: H.M. Stationery Office, 1943.) 10*s*. net.

DURING recent years one of the most important advances in relation to the growth of field crops has been the recognition of the important part played by minute traces of elements other than those usually applied as fertilizers. Deficiency of any essential nutrient is reflected in some way in the growth and colour of the plant, and Dr. Wallace has performed a useful service to all agriculturists by collecting and describing a series of one hundred and fourteen colour photographs of various crops showing mineral deficiencies. The aim is to provide a means whereby deficiencies can be recognized and rectified at an early stage of growth, so enabling a full crop to be obtained. A scheme is indicated whereby land of unknown cropping potentialities can be tested by growing a series of indicator plants with various fertilizer treatments, the indicators being selected for their special susceptibility to a wide range of deficiencies. Where a visual diagnosis is doubtful the matter can often be settled by simple methods of spraying, responses to such treatments usually appearing within ten or fourteen days. Special attention has been given to the most urgent questions of war-time production, deficiencies such as copper, zinc and sulphur, which are not known as practical problems in Great Britain, being omitted. The illustrations, with the accompanying diagnostic key, provide a fund of most useful information.

Encyclopedia of Substitutes and Synthetics

Edited by Morris D. Schoengold. Pp. 382. (New York: Philosophical Library, Inc., 1943.) 10 dollars.

THIS "Encyclopedia" is very lavish of space: not only is it set out with a wealth of 'leads' that reminds me of much pre-war practice, but also the diction is in many places unnecessarily verbose. For example, instead of stating that atabrine is slightly soluble in water, there is a sub-heading "Solubility", and well below the words "Soluble in water only to a slight extent". The very wide spacing and the reiterated sub-headings may make for easy finding, but a more compact form of presentation, with some tables of physical constants, etc., would have reduced the size, weight and price of the volume, or allowed of the inclusion of many more uses.

A few curious statements have been noted: in referring to the production of ammonium sulphate by the destructive distillation of coal, it is asserted that "If the ammoniacal vapors are conducted into sulfuric acid and then crystallized and dried, ammonium sulphate of commerce is obtained". Calcium phosphate and calcium sulphate are both described as white powders which are found free in Nature. Despite such blemishes the book will be found useful by all who need up-to date 'potted' information on substitute and synthetic materials. E. H. T.

Dictionary of Science and Technology in English—French—German—Spanish

By Dr. Maxim Newmark. Pp. xvi+386. (New York: Philosophical Library, Inc., 1943.) 6 dollars.

THIS dictionary contains ten thousand English terms that are frequently used in the physical sciences and their applied fields, together with separate indexes in French, German and Spanish, conversion tables and technical abbreviations. The total number of entries, including cross-references, is about fifty thousand. The English part is divided into alphabetical sections (A, B, C, etc.); each word is followed by its equivalent in French, German and Spanish, always in that order, and a number. Parts containing the foreign words follow, each word bearing a letter and a number referring to the English part. An example will make this clear:

Border, chaudière *f.*; Dampfkessel *m.*; caldera *f.* . . . [354].

Chaudière, B354;

and similarly for the German and Spanish words.

This arrangement saves an extraordinary amount of space, in comparison with the arrangement usual in polyglot dictionaries. The pure sciences included are chemistry, physics and some mathematics. Of the applied sciences engineering, in all its branches, is particularly well treated, but meteorology, navigation, and photography also receive attention.

The book is a credit to the institution where it was conceived—the Brooklyn Technical High School.

E. H. T.

ANTHROPOLOGY IN RECONSTRUCTION

By PROF. F. C. BARTLETT, C.B.E., F.R.S.

I MUST confess to a considerable reluctance to repeat, word for word, a lecture which is already printed. I propose, therefore, to attempt a rather rapid summary of the printed form of my Huxley Memorial Lecture* and then to devote my attention to certain problems which could not, in that form, be considered.

I have assumed that anthropology should take a leading interest and share in all future construction or reconstruction of human society, and that if it is to do this it must enter into very much closer working relationships with other scientific disciplines, both physical and biological, than have ever so far been achieved. Further, if the claim that it can do this is to be fully substantiated, anthropology must now, and for some time to come, seek its main data in the empirical and, so far as possible, the controlled study of the behaviour of contemporary social groups.

This view is unquestionably biased and partial. It implies that anthropology is to take over and apply to whole populations those problems of the determination of behaviour and behaviour changes which psychology studies with its eye on the individual. It believes anthropology to be interested, like any other science, chiefly in causal sequences and relations within its proper sphere of study. It accepts the view that one of its primary aims is to be able to say that if any given population is submitted to particular conditions the probabilities are that these will issue in a particular sort of behaviour.

Not for one moment do I wish to suggest that these are the only problems which anthropologists will tackle. There are many others of a historical, descriptive and topographical character which have been a main concern of the subject and will, I hope, continue to be studied vigorously. But I do urge that these, especially as they affect contemporary group-life, are now of paramount importance, and should be given some priority.

The study of man is, and always has been, too vast to be a proper concern of any one investigator, of any one school, or of any one method of approach alone. Whenever it has kept close to empirical fact it has tended to split up into a number of related disciplines of study, of which four are frequently distinguished. They are: (1) physical anthropology or anthropometry; (2) the study of the effects upon group behaviour of general environmental conditions, particularly of climate, natural economic resources, lines of transport, and the size and trends of change of population; (3) the study of the applications of whatever natural knowledge is current within a group at the time at which it is being investigated and of their influence upon behaviour; that is to say, the survey of what is often called 'material culture'; and (4) the study of a group's psychological possessions, its traditions, beliefs, customs, ideals and of their repercussion upon social conduct: that is to say, of what is often, but not very well, called 'social culture'.

It may be a matter of surprise to many that I have given no specific place to archæology. This is not due to any disrespect for a wide and most fascinating field of investigation, but rather because it seems to me that archæology should either be regarded as a subject to be cultivated for its own sake, largely and inevitably descriptive, or else as a line of approach which can be adopted towards any or all of the four main branches of anthropology which I have mentioned.

On the whole, anthropometry has produced somewhat disappointing results. There are many reasons for this, but the primary one appears to be that the bodily characters chosen for measurement have, most of them, no clear and unequivocal relations to behaviour. Particularly behaviour does not regularly vary with simple changes in the size and shape of these characters. I believe that the time has come for a strong attempt to establish a genuinely functional anthropometry in which the leading idea will be to select for measurement only those characters the presence, distribution, or absence of which have a demonstrable bearing upon large-scale social activities.

For example, in the early days of the present War, it became possible to carry out an extensive survey of intelligence levels in a representative section of the population of Great Britain. At the same time, details about professional and industrial occupations were recorded. From the analysis of the results secured it can be stated reasonably accurately what are the probabilities that a person of known age in England in 1939–40 will be found within a particular occupational range. The range is a relatively large one for the middle levels of intelligence and becomes much more restricted at the extremes.

A statement of this kind is psychological. But suppose we could obtain a similar survey of intelligence levels and their distribution, in any comparable group, where new or changing developments in industry were desired, we could begin to predict what industries and professions could reasonably be encouraged within this group. That would be an anthropological statement.

The matter does not stop there. Occupational proficiency depends not only upon intelligence level, but also upon a variety of practical skills depending in their turn upon measurable qualities, or functions, of fingers, hands, arms, legs, lungs, heart, eyes, ears and central control. If we can get—a not impossible task—reliable data about the levels and distribution of these in any population, we can make our predictions of the extent and range to which occupational opportunities can be successfully stimulated within that population more accurate.

Other conditions must be studied as well, and to some of these I will turn in a moment. Meanwhile, one conclusion is inescapable. The measures required for the development of a functional anthropometry are all of them physical, physiological, neurological, biochemical and psychological. To understand the bearing of these measures upon occupation, a clinical, often a directly medical, outlook is demanded. The data are required on a large scale and their distribution is as important as their bulk. Hence the expert statistician must work on them, perhaps developing new statistical technique to do so.

When all this is done, however, from our present point of view, we have got only data and the means of assembling them. The problems remain anthropological. They require people who are able to appreciate key points in large-scale behaviour and how to deal with them. A functional anthropometry which is to be used in the service of anthropology calls now for a development of wider and more intimate team-work than has been achieved or even generally been considered necessary.

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*Anthropology in Reconstruction. The Huxley Memorial Lecture for 1943. By Prof. F. C. Bartlett. Pp. 8. (London: Royal Anthropological Institute, 1943.) 2s. 6d. The article printed above consists substantially of the lecture as it was delivered.

The study of human functions and their distribution will never give the anthropologist all he wants. Basic human activities may, for example, favour the development of heavy industries. But if climate, economic resources, lines of transport and size and trend of population are separately or together against them, any prediction based upon the anthropometry of the situation is likely to be of little moment. At the same time, the investigation of these general environmental influences demands just the same co-operation of many-sided effort and development of team enterprise. As a result of the stimulus of a world-wide war, for example, much more detailed information is now available about the precise effects of extremes of climate, and, a matter of special importance, of how to counteract, change and direct these, particularly by nutritional agencies. By brilliant scientific discovery, the effects upon group behaviour of immediate economic resources, of lines of transport, and in consequence of the size and trends of populations, have been vastly altered. The discoveries are in part physical and chemical and in part biological. Very often again, they have a strong medical interest. In this sphere also, therefore, a wide development of team-work is needed, so that the best methods may be applied to collect the most reliable and relevant data, and at the same time the significance of the data for an understanding of group reactions may be kept in view.

The story remains unaltered if we turn to the field of 'material culture'. Nothing has changed more rapidly or radically all over the world in recent times than material culture. Nothing has altered the ordinary everyday life of people, for good or ill, more profoundly than rapidly following applications of natural knowledge.

I think that, without giving up its long-established habits of studying very early developments of applied natural science, it is time that the anthropological study of material culture made more serious attempts to understand how the later products in the same line are affecting the lives of men. The physicist, chemist, engineer and biologist are the modern social reformers, though they rarely set out to be, because it is their discoveries which are the most widely applied to produce the quickest results. To understand how science revolutionizes the day-to-day life of man in every region of the world, and to appreciate fully how this influence is likely to be still further extended, once more needs collaboration between the anthropologist and all other natural scientists.

Of all branches of anthropological investigation it will be readily understood that the one which must interest the psychologist most of all is that which has to do with a group's less tangible possessions, with its institutions and their functions, with its customs, beliefs, trends and ideals. We may know all that can be known about levels and distribution of human capacities, about the influence of material culture, and still we shall only imperfectly understand, or be able to foretell, what changes will befall a group, and whether they will be transitory or permanent, until we can know the pattern of psychological possessions into which they must fit. To know this I think the psychologist and the anthropologist, to the great gain of both, must come more closely together than they have ever yet done. The last ten years or so have been a period of intense activity on the part of psychologists all over the world who have been interested in the social aspects of their science. They have invented and applied all kinds of special methods for the collection of evidence of a reliable nature about social attitudes, beliefs, opinions and the like. They have tried to find what forms of question, and what conditions of their application, can be most trusted. We now have an almost bewildering variety of possible lines of approach. There are questionnaires, with many special devices for getting representative samples of replies. There are interest inventories, opinion and assessment scales for rating social attitudes and activities. There are diverse forms of special interview. Prof. K. Lewin and his students, and many others as well, have begun to try experiments with partially controlled social groups. Elsewhere the beginning of a direct experimental attack has been made upon the problem of how, in fact, people anywhere do actually think about social questions. Efforts have been made, though these have usually been anything but sympathetic to psychology, to develop particular ways of observing mass behaviour and mass opinions. Still further removed from any official psychological countenance or free participation have been the tremendous and disturbing attempts to force public opinion and action by organized propaganda. The methods exhibit every degree of control, partial control and complete uncontrol. Almost every one of them has been used to point to conclusions, which have frequently been stated with exasperating dogmatism, and are of a kind that any anthropologist, who usually has a very much wider knowledge of comparative history, can treat with legitimate derision.

Yet derision is only rarely along the way of progress. The methods are here. They will be used. Indeed it is true to say that under the stimulus of a war which has made it necessary to plan for controlled behaviour in very large populations, those people, unfortunately fewer than they might be, who want plans to rest on evidence have turned more to the eager empiricism of the psychologist than to the more widely based and perhaps more dispassionate judgment of the anthropologist. Here then, in the study of social culture, let us work to forge a link, closer than ever before, between these two sciences.

Wherever we turn now we find scientific specialists with methods of ever-increasing accuracy for the establishment of knowledge about the great forces of Nature and their impact upon human kind. It is not surprising if sometimes those who follow this path allow the very intensity of their search and the demonstrable accuracy of their results to tempt them to premature generalizations which anthropologists, with a fairer knowledge of the wide sweep of history, and the enormous divergencies in and of human social groups, can reshape to better purpose.

In this rapid survey I have tried to show that the future for an anthropology which will understand and perhaps help to guide the destinies of man lies in a closer and more friendly relationship with all the special sciences, and particularly with all biological studies. The meticulous and attested knowledge we now must have. There is no escaping from that. Many men will play many parts, each branch of learning maintaining and increasing its integrity while yielding up its isolation.

I have suggested that the study of the distribution of fundamental human activities, of those factors which I have included under general environmental conditions, and of the impact of modern developments of material culture, are all needed in order that we may reasonably estimate, in a rather abstract manner, what kinds of change could occur, or could be planned to occur, in specific groups, as a result of contact. But if these abstract possibilities are to be given any concrete status, they have to be considered in the light of studies belonging properly to social anthropology.

Let me use what may appear to be a somewhat trivial illustration. The people of Great Britain have recently received many invitations—if such they may be called—to change their food habits. On the whole, they seem to have done this with astonishing ease and success, when they have been left to decide how to do it for themselves. I do not know, but I suspect, that if a survey were made it would be found that, under these conditions, while food content has become much more uniform, meal-timing exhibits just as much diversity from one section to another of the population as it ever had. But there are large sections of the public for whom both the content and the timing of principal meals are prescribed pretty rigidly, and naturally the content is, or so it is alleged, determined chiefly by biochemical considerations in relation to economic possibilities, and the timing by industrial ones. Every anthropologist knows that food habits are ticklish things, and that whereas some communities change them with astonishing readiness, others resent and resist change just as naturally. I have no inside knowledge, but for what it is worth my own observation and information lead me to believe that if anybody liked to look into the matter he would find that often, when a noble meal of roast beef, potatoes, cabbage and the like is provided, a substantial proportion of the population for whom it is designed would be found sitting about in or out of their canteen, eating food obtained from their own retailers, and prepared in their own homes. If an anthropologist were asked about this, I think he would say, "First let me carry out a rapid survey of the food habits and their timing of these people, of their regularity and permanence". Then, perhaps, some scheme could be achieved which would satisfy the nutritionist, the economist, the industrialist, the Government officer, the anthropologist, and, most important of all, the people who must eat what is provided when it is ready. For all I know, this may have been done, but it does not appear to have been done on any considerable scale. I wonder why ?

The main reason may be that there is as yet no general recognition of the fact that the speed, permanence and harmony with which any change of culture can be effected, whether it is planned or achieved without any deliberate planning, depend more upon how it is related to what I have called the group's 'psychological possessions' than upon anything else.

If we are to tackle the difficult and intricate problems of what changes are most likely to happen when different cultures meet, we must have some fairly definite guiding ideas. I suggest that a primary aim now should be to search for methods which will enable us to say with some certainty what are the 'hard' and what are the 'soft' points of group or sectional culture. The 'hard' points are those which will resist change, the 'soft' points those which will readily yield and open the way to peaceful reform.

To determine what is now called 'culture pattern', even when this can be done with wide assent, is not enough. A pattern is too independent of its detail, which may change almost indefinitely, at least within wide limits, leaving it recognizably the same. But in the case of culture it is the detail, quite as much as its relation to other details, which presents the obstacle or offers the opportunity.

First, very obvious and prominent differentiating points of contrasting cultures seem to be more often 'hard' than not. But just because they stick out and are possessed by one side only, they are often, especially by the reformer in a hurry, considered to be mere unimportant detail. It is not a bad rule to avoid hitting first and openly at manifestly differentiating points.

Secondly, if one of the four main lines of approach which I have discussed suggests that a specific change may readily occur as a result of contact, it is very tempting to expect, or even to plan, for such change. But this is always misleading evidence. For example, we may demonstrate a reasonable level and a wide dispersion of mechanical abilities in a community and at once set up a system of training suitable to modern highly mechanized industrial life. But if economic, political and social influences are adverse, this will only encounter in the end the hardest of all 'hard' points of culture. For it will set lots of people along some path of purpose and then stop all but the lucky few from reaching the goal Many a partially thought-out scheme of education has foundered on this rock.

Thirdly, although the pattern concept is not by itself enough, it does seem true to say that the hardness or softness of cultural detail does depend on their 'lines of intercommunication' within the community; and it may be hazarded that detail is the more likely to change in proportion as it has some tangible expression which is dissociated from a group's psychological possessions, and less likely in proportion as it has little or no expression in the material side of culture.

To these tentative suggestions I now wish, though in no dogmatic frame of mind, to add one or two more. The social anthropologist who sets out to see methods for deciding hard and soft points in particular cultures is almost at once brought up against historical problems. The psychological expressions of culture usually, maybe always, have roots deep down into the past. How deep must we dig ?

In the strange period of interlude between the two great Wars, psychology has been overrun by the view that everything that happens in human life is determined in and by the remote past. A rapid series of developments are pictured in early infancy, and after that, childhood, adolescence, the prime of life and old age merely succeed in donning a tremendous variety of disguises. Since the disguises are infinite in number, though often stereotyped in character and all represent the same rather unpleasant pattern which is considered to be fixed before and soon afte birth, this is one form, very extreme, of the explanation by culture pattern.

Anthropology has, I believe happily and honourably, escaped the greatest and gloomiest extravagances of this view. But not entirely. There are those who see in every group activity nothing but a disguised repetition of motives, impulses and event first played out in some long-gone cradle of mankind. The present and the future of all group developmen are tied to an unchanging past, and the apparent novelty of their forms is only an illusion. Explanation is a one-way traffic.

I wish to enter a very strong plea for the perfectl naïve study of trends and ideals in social culture. I believe that if these are taken at their face value, and not merely interpreted in terms of archaic symbols and imaginative social origins, they will reveal, perhaps more readily than anything else, the soft and yielding points of any culture. In one way and another the study of man seems to have come into a period in which it is fashionable to treat trends and ideals with suspicion, and the more noble they may appear the more they are suspected. They are treated as tricks obscuring some unchanging struggle between primitive social instincts. It is time to call a halt to all this. There is no great difficulty and I think no great honour in showing that the trends and ideals by which modern social groups are organized have grown out of sorry beginnings. They are none the less achievements, often proud achievements, and if they are considered very simply, as any man of honest common sense will treat them, they can be seen as the pathfinders lighting the way to a knowledge of how cultures that meet will most powerfully interact.

There is another question the answer to which, it seems to me, anthropology, with its wide and minute study of comparative social history, can seek with more promise than almost any other branch of knowledge. This is the question, supremely important at the present phase of human affairs, of the time that may be expected to elapse before changes brought about through social contact can become established. Everybody must have noticed that it seems a lot easier to say what changes are likely to happen when two groups meet than it is to say when they will occur. This may be because, as many people think, the problem is insoluble, except by guesswork, or it may be, as I prefer to think, because it has rarely, if ever, been intensively studied by a combination of experimental and comparative methods and with a full appreciation of the immense influence of modern scientific invention and educational practice.

From the experimental field proper comes at least one glimmer of promise. Innumerable studies have been made of learning processes in animals and man. It is true that in most of these the balance of attention has been towards what is learned rather than towards the time of assimilation and establishment. But times have been plotted with great accuracy, and in the last few years it has become apparent that it *is* possible to state with reasonable accuracy how long it will take many new processes to be established, not only in the individual, but also in the group. Always, I think, the time is longer than the natural optimism of the innovator would like. Both the experiments and their applications have concerned selected groups alone, and so we are very far still from being able to apply the knowledge gained to the unselected and very diverse populations most often affected by culture contacts. But one thing has become very clear. Whenever the new process has to be exploited by a group, working as a group, the material and social possessions of that group, as they are when the process is introduced, must be considered. I do not think it is foolish to assert that an intensive comparative anthropological research, backed by a judicious use of experiment, could begin to predict with greater accuracy the timing of social change.

More: we know now that, with selected groups, it is possible to use methods to accelerate the establishment of the new and the discarding of the old. Why should the social anthropologist not look, in his field observations, for the ways in which these methods work in the unselected social community? It is not impossible.

Most people believe, and it is probably true, that the quickening of the means of communication and the enhanced control of natural resources which modern science has made possible have greatly accelerated the rate of change brought about by culture contact. It is an unevenly distributed acceleration, much more apparent in the fields of material culture than elsewhere. It may produce a false and a dangerous optimism—indeed, I think it has already done this—which may work havoc in the post-war world, unless the timing of the changes which one community can introduce into another is studied as scientifically as are the most favourable points of entry of such innovations.

One further consideration. It is not uncommon to find some feature of encroaching culture, coming from outside, apparently received into a group, and even given an enthusiastic welcome; but within a short time it has lost its place. Either it has gone as if it had never been, or it has changed into a form so identified with some pre-existing group of elements that it has lost all its integrity. Finding points of favourable entry is necessary, but it is not the same thing as discovering means of ensuring permanence. This is a task possible only for the anthropological team working in the field. I must confess that my field anthropological experience is lamentably slight, and it is with apologies that I use a case which came within my own attention.

However, I did once arrive at a fairly remote African group at a time of minor crisis. Certain practices, popularly denominated "witchcraft", had just been, for admirable reasons, blankly and with penalties prohibited. They were 'hard' points of culture and the chief effect was to drive them underground. When I arrived certain men, called "witch-doctors" by all the European inhabitants, were suffering periods of enforced inactivity. Naturally I looked them up, and it seemed clear that one or two at least were men of superior intelligence and alertness of mind. As soon as good relations were established they talked freely, and although I was in the unsatisfactory position of having to use an interpreter, one thing impressed itself on me at the time. I tried as simply as possible to explain a little about our own practice of psychological medicine. Perhaps it was only my fancy, but I thought I was met by a quickness and sympathy of understanding and an interest not by any means very common yet in the European world.

I think, if the possibilities of this had been more fully realized, the situation might have been better handled by the representatives of the European culture, but I had no chance to experiment and so far as I know nobody has tried this experiment since. I have, however, often looked for cases in which cultural change induced by contact has endured and at the same time maintained a certain integrity.

It does seem to me possible to collect a few general suggestions which may be used to guide the necessary further field research. If some detail is detached from one social setting and passes into another, it is exceedingly unlikely that it will survive for long in its original form. The most likely thing, if it persists at all, is for it to appear as a detail integral to the receptive culture. There are cases of endurance in such circumstances but, though I cannot claim wide knowledge, I know of none in which the detail exchanged acquires any functional importance in its new setting.

If items that are transferred are to endure in approximately their original form and function, they must be given a concrete expression—something that can be seen, or heard, or performed; and this is the more important the more unselected and diverse is their new social group. There appears to be an intimate relation between certain types of expression and certain classes of item, and I think that to clear up and formulate these should be a primary object of field study.

The permanence or transitoriness of changes induced by the contact of cultures is closely dependent upon the link between these changes and other material in both the transmitting and the receiving groups. In other words, there is much truth in the view that culture moves in blocks. But very little is known about either the nature of the links required or about how they work. Nothing but directed research in the field can make these clear.

Finally, I suspect very strongly that no group can influence another permanently, except by establishing very friendly working relationships with a group which already possesses some social prestige within the receptive community, and the prestige of which will manifestly increase if it accepts and gets, to begin with, something like a 'corner' in the incoming reforms.

How do I picture an anthropology with a wider understanding and a greater potential power of guidance of the destinies of man? Certainly I do not see anthropologists as administrators, or administrators as anthropologists. The basic need is for the further development of anthropological research and teaching. If these grow as I see them, they will themselves constitute a co-operative effort in which many interests will combine. Perhaps in this way the immediate future of anthropology may become a mirror of the future of the wider world of mankind.

BLOOD PIGMENTS AND RELATED SUBSTANCES

A MEETING of the Biochemical Society held on November 13 was devoted to papers and discussion on "The Tetrapyrrolic Pigments".

Prof. D. Keilin gave an introductory survey of the properties and functions of natural tetrapyrrolic pigments. The iron derivatives of porphyrins, or hæmatins, form the active or prosthetic groups of many biologically important substances: hæmoglobins, cytochromes, catalase and peroxidase, which play fundamental parts in oxygen transport and cellular oxidations. The iron atom of hæmatin lies within the flat tetrapyrrolic ring system united by four covalencies to the pyrrol nitrogen atoms, while the remaining two valencies lie above and below the ring.

The porphyrins are highly fluorescent in ultraviolet light and show sharp absorption spectra. Although they combine with many metals, only the iron derivatives combine with proteins forming intracellular catalysts. The proteins are not colloidal carriers but integral parts of the molecule, and various proteins can combine with the same hæmatin to give catalysts of widely differing properties. The sharp absorption spectra of intracellular hæmatin compounds, particularly of the cytochromes, make possible the detailed study of cellular respiration by spectroscopic examination. All aerobic cells can synthesize the porphyrin nucleus and build up specific hæmatin catalysts. Anaerobic bacteria are devoid of hæmatin. A few exceptions to this rule are aerobes normally living in presence of hæmoglobin, for example, *Hæmophilus influenza* and *H. canis*. Cultures of these organisms need the addition of protohæmatin or protoporphyrin as a growth-factor.

The work of Pauling and Coryell on the iron-porphyrin linkage divides hæmatin derivatives into two groups; in one the linkages are covalent and in the other mainly ionic. Oxyhæmoglobin belongs to the former and hæmoglobin to the latter—an unexpected result which can only be explained by a fundamental electronic re-arrangement within the oxygen molecule when it combines with hæmoglobin.

The facile oxidative degradation of hæmatin *in vivo* to bile pigments, involving the opening of the porphyrin ring to a straight-chain tetrapyrrol, is in strange contrast to the great stability of porphyrins over millions of years in bituminous oils and coproliths.

Prof. H. Munro Fox dealt with the varieties of hæmoglobin. All hæmoglobins contain the same hæmatin nucleus, but the globin varies with the species and even within the species. Hæmoglobins of some invertebrates (erythrocruorins) differ from those of vertebrates in that they show high molecular weight, low iso-electric point and markedly different amino-acid analysis. Hæmoglobins of animals differ in many ways; for example, in spectra and in oxygen affinity. In the case of rabbits, spectrum differences have been observed among individuals. These differences must depend upon variations in globin structure, as also must the antigenic properties. Sir Joseph Barcroft's work on fœtal respiration has demonstrated the vital higher oxygen affinity of fœtal over maternal hæmoglobin.

The role of hæmoglobin in invertebrates seems less vital. Not only is its occurrence rare and very spasmodic, but also some species such as Chironomus can survive gassing with carbon monoxide. The respiration of this worm is only affected by carbon monoxide at very low oxygen pressures, when presumably the hæmoglobin comes into play as a carrier. A remarkable case of hæmoglobin increase in response to oxygen deficiency is that of Daphnia, which will change in a few days from bright pink when oxygen is deficient to colourless in well-aerated water, and vice versa.

The question of the formation and maintenance of hæmoglobin in invertebrates came up for discussion. In vertebrates the bone marrow controls hæmopoiesis, and the hæmoglobin is maintained in the ferrous state by specific intracorpuscular reactions. It is difficult to propose any corresponding mechanisms in invertebrates.

The function of tetrapyrrolic pigments in plants was reviewed by Dr. R. Hill. The fluorescence of porphyrins is decreased on combination with metals except in the case of the magnesium derivatives, and it is therefore understandable that chlorophylls, as photosynthetic agents, are magnesium porphyrin compounds.

Besides chlorophylls *a* and *b* in the ratio 3 : 1, a third derivative, protochlorophyll, with two hydrogens less in the porphyrin ring, may occur in higher plants. A fourth member of this class, chlorofucin, occurs in diatoms and brown algæ. The red, blue and green algæ all contain chlorophyll *a* together with varying amounts of two fluorescent bile-pigment protein complexes, phycoerythrin and phycocyan. Many algæ show the property of chromo-adaptation and, when grown under coloured light, may assume the complementary colour.

The respiration of plants is catalysed by the same types of tetrapyrrolic compounds as are present in animal tissues. A plant extract has been obtained which shows the same cytochrome spectrum as that of baker's yeast or washed muscle tissue and will oxidize *p*-phenylenediamine and succinate. The oxidation and reduction of cytochromes can be observed spectroscopically in plant tissues. Two other specifically plant cytochromes have been isolated but their function has not been established.

In subsequent discussions Prof. Keilin described experiments proving that the cytochrome oxidase system and not the polyphenol oxidase is responsible for the bulk of plant respiration. The evidence was based on the effect of carbon monoxide on respiration. With the former enzyme the effect of carbon monoxide is sensitive to light; with the latter it is not.

The problem of the constitution of catalase was considered by Dr. E. F. Hartree in two ways: its close analogy with methæmoglobin, and the significance of the bile pigment derivatives normally found in the highly purified enzyme. The close analogy of methæmoglobin with peroxidase and catalase is apparent from colour and absorption spectra, and also from reactions with respiratory inhibitors such as cyanide, azide and sulphide. The spectrum changes obtained on addition of these inhibitors, and also of hydrogen peroxide and organic peroxides, show that atalase contains hæmatin, with trivalent iron, combined with a specific protein.

The isolation of biliverdin from catalase on treatment with acid acetone, together with a study of the hæmochromogens obtained from catalase after the addition of pyridine, indicate the presence of a bile pigment–iron–protein complex in catalases which appear homogeneous by physical criteria. Although it was at first accepted that the catalase molecule ontains one bile pigment grouping and three hæmains, it was later proved that the bile pigment plays no part in the activity of the enzyme and is not herefore built into the molecule during synthesis. The bulk of the evidence suggests that the bile pigment groups are the result of oxidative degradation of catalase hæmatins during normal metabolism, and are not formed during the processes of extraction and analysis of the enzyme preparations.

The findings of Keilin and Hartree on the ability f catalase to promote an oxidation of certain substances by the 'active' hydrogen peroxide formed during certain enzymic oxidations were brought forward to support a theory of catalase degradation *in vivo*. It was suggested that such a coupled oxidaion of catalase occurs in the liver, which produces hydrogen peroxide during certain oxidation reactions. n this way the facile oxidation of catalase in the liver can be reconciled with its resistance to degradation by treatment with high concentrations of ydrogen peroxide. This question of an active or nascent form of hydrogen peroxide was taken up in the ensuing discussion, when an example of a similarly active form from an inorganic source (decomposition of barium peroxide) was cited.

Dr. J. R. P. O'Brien's paper reviewed the present state of our knowledge of the hæmoglobin molecule based on physico-chemical and X-ray measurements, and the synthesis and breakdown of hæmoglobin; processes dependent on the activity of the bone marrow and the liver.

The theory that globin is attached to iron via iminazol groups finds support in *p*K measurements of iminazols, but there is no evidence that the iminazol ring of histidine is involved. Histidine is found in all hæm proteins, consequently the unique globin-hæm linkage conferring the property of oxygenation is more likely to depend upon some group peculiar to globin. In this connexion it must be borne in mind that less than 70 per cent of the globin molecule has been accounted for by amino-acid analysis.

Porphyrin production can be maintained under adverse conditions, though the iron and globin supplies for hæmoglobin synthesis depend largely on dietary supply. The mode of synthesis of hæmoglobin is unknown, though further knowledge of the structure of the molecule as, for example, is available from the X-ray measurements of Perutz, may shed light on this problem. The first stage in hæmoglobin catabolism appears to be the 'easily splittable iron' of Barkan, which accounts for about 5 per cent of erythrocytic iron. The process then passes via biliverdin and bilirubin to urobilin. The latter is partly excreted as such and partly after further breakdown to pyrromethines.

The beneficial effect of ascorbic acid in T.N.T. methæmoglobinuria indicates the necessity for a reducing agent within the erythrocyte to maintain hæmoglobin in the ferrous state. This mechanism may be intimately connected with glucose metabolism.

In the discussion that followed, the absence of the Soret, or γ, band in the absorption spectrum of red-cell suspensions was considered. Prof. Keilin brought forward evidence that this is a purely optical phenomenon and cannot be accounted for by the theory of a hæmoglobin-stromatin complex. Thus the band is absent from a suspension of hæmoglobin droplets in oil.

Dr. C. Rimington dealt in detail with the pathological conditions in which large quantities of uro- and coproporphyrins are formed and excreted. Free porphyrins occur normally in small quantities in plants, bacteria, yeasts, and many animal tissues. Protoporphyrin does not appear in pathological conditions, while the uro- and coproporphyrins each appear in two isomeric forms (Series I and III of Fischer). It is not possible to regard one as normal and one as pathological. While the coproporphyrins are normal constituents of urine and fæces, the presence of uroporphyrins must be regarded as pathological, although certain squirrels excrete large quantities. The most striking instance of uroporphyrin production is in the *turacos*; these African birds have wing feathers coloured bright red by copper-uroporphyrin III.

The porphyrinopathies may be divided into three groups: (1) *Porphyrinuria* may be brought about in any person by certain factors; for example, hepatic dysfunction, lead or sulphonal poisoning. Urinary coproporphyrin is greatly increased. (2) *Porphyria congenita* is a rare condition present from birth and probably hereditary. Copro- and uroporphyrins are excreted in large quantities in the urine and fæces, and the teeth and bones are brown. The photoactive porphyrins produce considerable photosensitization. A similar disease is known in cattle. (3) *Porphyria acuta* appears later in life. There is no bone pigmentation or photosensitivity, but much porphyrin is excreted during attacks. Other sets of symptoms may predominate and the disease is usually fatal.

Porphyrins are to be regarded as products of deranged hæmoglobin synthesis rather than as degradation products. Further knowledge of hæmoglobin synthesis will no doubt help to elucidate the problems of the abnormal production of porphyrins.

This meeting was very successful, but could have been improved by the allotment of more time for discussion of the many interesting points raised by each contributor. Sir Joseph Barcroft, in his concluding remarks, expressed the hope that the proceedings would be published *in extenso* to allow a more careful study of a valuable contribution to our knowledge of the tetrapyrrolic pigments.

OBITUARY

Dr. W. H. Hatfield, F.R.S.

Dr. William Herbert Hatfield, director of the Brown-Firth Research Laboratories, Sheffield, who died on October 16 after a very short illness, had played a leading part in the development of metallurgical research in Great Britain, besides holding an important position in the steel industry. He was born in Sheffield on April 10, 1882, and worked in the laboratory of Messrs. Henry Bessemer and Co., studying at the same time at University College, Sheffield, under Prof. J. O. Arnold.

Hatfield went to the firm of J. Crowley and Co. as metallurgist, and while there published his first original research, a study with Prof. A. McWilliam of the elimination of silicon in the acid open-hearth. A second joint paper on the same subject followed in 1904. He was awarded the Mappin Medal and also a Carnegie Scholarship, which led to the publication in 1906 of a memoir on the forms of carbon in cast iron. In 1909 he developed this subject further, and showed that, contrary to the widely accepted statements of Wüst, it was not necessary that carbon should be precipitated as temper graphite before being oxidized in the production of malleable castings. The experiments, which were well designed to settle the point, were conducted in the works, the microscopical studies being made in Prof. Arnold's department, now a faculty of the University. These investigations were next expanded into a book.

In 1916 Hatfield succeeded Mr. Harry Brearley as director of the Brown-Firth Laboratories, and gathered round him a technical staff. Brearley had in 1912 invented the first 'stainless' steel, a high-chromium steel which when correctly heat-treated was highly resistant to corrosion, and found special application in cutlery. To administer the patent rights the Firth-Brearley Syndicate was formed. In the meantime, Messrs. Krupp of Essen had covered by patents a wide range of steels containing both nickel and chromium, with the primary object of using them for high temperatures, although their resistance to corrosion at atmospheric temperatures had also been noted. Hatfield made a thorough study of these steels, and selected 18 per cent chromium and 8 per cent nickel as giving the most useful results when suitably made and treated. This "18 : 8", to which Firths gave the name of 'Staybrite', became the most widely used of this series of alloys, and its success was largely due to the energetic efforts of Hatfield. He made a detailed study of the properties of the austenitic stainless steels, especially of the intercrystalline corrosion to which they were liable under certain conditions, as when welded. This difficulty was overcome partly by keeping the carbon content low and partly by adding carbide-forming elements, such as titanium. The activities of his own firm, of which he became a director, led him to give much attention to steels for guns, aircraft and marine forgings, and his later researches dealt mainly with alloy steels, especially with mechanical properties, behaviour at high temperatures, resistance to creep, and corrosion.

As a result of experiences in the War of 1914–18, certain research committees were set up by the Iron and Steel Institute, but after the first enthusiasm had passed there was a danger that their ambitious programmes might be dropped, and it was owing to Hatfield that a definite scheme was put in hand in 1924 with the object of determining the nature and causes of heterogeneity in steel ingots. This Ingots Committee, of which he was chairman, was followed by similar committees on corrosion, alloy steels, and steel castings. These and other committees and sub-committees were co-ordinated under the Iron and Steel Industrial Research Council. There is no doubt that this organization, which has been and still is responsible for co-operative research in the steel industry of Great Britain on a large scale, owes its success very largely to Hatfield, who had the art of persuading manufacturers to co-operate by pooling information, contributing money and materials, and undertaking experiments in their works, while universities and public institutions such as the National Physical Laboratory were effectively brought into the scheme.

The present War brought Hatfield new and heavy tasks. As chairman of the Technical Advisory Committee on Alloy Steels, he was instrumental in reducing to a small number the great mass of steel specifications, thus simplifying the work of the steel maker and economizing the rarer metals. In the summer of the present year he was a member of an iron and steel mission to the United States, which he had visited once before in 1928, when he gave a series of lectures afterwards published in book form. The extra strain no doubt told on him, and although his health had seemed invulnerable, the end came rapidly.

Hatfield enjoyed controversy, and in committees could be deliberately provocative, but it was possible to differ strongly from him either on scientific matters or on questions of policy without any break of personal friendship, for he was incapable of bearing malice, and differences were soon healed. Sheffield, where most of the research committees usually met,—will seem a different place without him, and he will be equally missed at the meetings of many technical societies. In 1907 he married Miss Edith Marian Seagrave, and he owed much during the stress of scientific and commercial work to the companionship and support of his wife.

Dr. Hatfield was elected a fellow of the Royal Society in 1935. He received the Bessemer Medal of the Iron and Steel Institute, of which he was a devoted member, in 1933, and became a vice-president in the following year. He founded the Sheffield Metallurgical Association, of which he was the first president, and held office in many other societies.

C. H. Desch.

NEWS and VIEWS

Foundation for Educational Research

THE Foundation for Educational Research, recently set up in association with the University of London Institute of Education, owes its origin to an offer of 10,000 dollars from the Carnegie Corporation of New York. This was made to encourage a 'carry-over' of interest in research from the work done under the directorship of Sir Philip Hartog by the English Committee of the Carnegie International Examinations Enquiry. The conditions attached to the offer were that the money would be paid over as equal amounts were subscribed in England, and that the fund should be administered by the Institute of Education. A generous grant of £1,000 from the Leverhulme Trustees thus made the sum of £2,000 available. As soon as conditions permitted, the Institute constituted an advisory council, and this body urged a considerable expansion of the original scheme so as to provide for a period of at least five years of systematic work. This expansion is now being put into effect with good hopes of wide support. The intention is that the present organization shall merge itself into a permanent national organization as soon as that stage can be reached. The first piece of work to be undertaken is a programme of researches designed to arrive at trustworthy diagnostic techniques for the 'sorting' of the young adolescent population which will be necessary in carrying into effect the White Paper proposals for post-primary education in Great Britain.

University Grants Committee

THE Chancellor of the Exchequer has announced that the membership of the University Grants Committee has been increased from ten to fifteen. It is constituted as follows: Sir Walter Moberley (chairman), formerly vice-chancellor of the University of Manchester; Dr. E. A. Benians, Master of St. John's College, Cambridge; Prof. W. E. Collinson, professor of German in the University of Liverpool; Sir Charles Darwin, director of the National Physical Laboratory; Miss Margery Fry, formerly principal of Somerville College, Oxford; Sir Robert Greig, director of the London, Midland and Scottish Railway, member of the Carnegie Trust for the Universities of Scotland and of the Agricultural Research Council; Prof. A. V. Hill, Foulerton research professor of the Royal Society; Dr. P. D. Innes, chief education officer, Birmingham; Sir Frederic Kenyon, formerly director and principal librarian of the British Museum; Prof. P. S. Noble, regius professor of humanity, University of Aberdeen; Principal Andrew Robertson, recently professor of mechanical engineering, University of Bristol; Prof. E. J. Salisbury, director of the Royal Botanic Gardens, Kew; Dr. J. C. Spence, lecturer on diseases of children, University of Durham; Prof. R. H. Tawney, professor of economic history, University of London; Sir Henry Tizard, president of Magdalen College, Oxford.

University of Oslo

AT the seventh meeting of the Conference of Ministers of Education of the Allied Governments, held in London at the offices of the Board of Education on December 7, with Mr. R. A. Butler, M.P., in the chair, the following message of sympathy and encouragement, with which the Conference associated itself, was handed to the Norwegian Minister of Education:

"We in Great Britain have been deeply shocked to hear of the brutal action by the German Occupying Power in Norway against the students and teaching staff of Oslo University. We are well aware that the arrest and threatened deportation of the flower of Norway's youth are designed to crush Norwegian intellectual resistance and to strike at those reserves of trained minds, which will be so badly needed during the post-war reconstruction period. We have watched with pride and admiration the unarmed struggle of your Nation. We have seen how your people have used the rich resources of their cultural and educational tradition, which we so greatly respect, to resist every attack by their oppressors. Norway's intellectuals have stood firm against trickery and enticement, against brutality and reprisals. All those concerned with education in Britain will join in sending our sympathy to our colleagues in Norway and particularly to Norwegian students and teachers. We know that this latest attack will be as fruitless as any other of the Nazis' efforts to subjugate the Norwegian people. We are confident that it will recoil inexorably on the heads of its instigators. Once more the Nazis have shown their determination to suppress every vestige of freedom of thought. The example of the Oslo students and teachers will strengthen the resolution of all defenders of liberty throughout the world."

Council for the Promotion of Field Studies

As a result of a preliminary investigation carried out by Mr. F. H. C. Butler, a meeting convened by him was held on December 10 at the British Museum (Natural History) to inaugurate a Council for the Promotion of Field Studies. Attending this meeting were some thirty-five delegates appointed by universities of England and Wales, university colleges, scientific societies and institutions, including the National Trust and the Council for the Preservation of Rural England. Prof. F. E. Fritsch was in the chair. Mr. Butler made a general statement of the aims of the proposed Council. He had found, he said, very strong support for his view that the facilities for study and research in the field needed to be much improved; one of the main functions of the Council would be to establish and maintain hostels for field studies, under trained wardens, in various parts of the country. It seemed to be widely felt that the Council could fill a very important gap in our system of education both at the school and university level. His address was followed by a full and interesting discussion; the motion to form the Council was then put to the meeting and carried unanimously. The following were appointed as officers and members of the executive committee: Mr. F. H. C. Butler, Primrose Farm, Little Wilbraham, Cambridge, honorary secretary; Mr. C. C. Fagg, honorary treasurer; Prof. F. W. R. Brambell, Mr. M. C. Burkitt, Dr. A. R. Clapham, Dr. H. Godwin, Prof. W. T. Gordon, Mr. L. A. Harvey, Mr. O. D. Kendall, Mr. N. B. Kinnear, Prof. W. B. R. King, Mr. R. H. Kinvig, Prof. W. H. Pearsall, Mr. H. J. F. Smith, Prof. A. G. Tansley, Mr. R. R. Tomlinson, Prof. C. W. Wardlaw, Prof. C. M. Yonge. The Board of Education will be represented by Mr. F. H. B. Fox and the Scottish Education Department by Mr. J. W. Parker, who will act in an advisory capacity.

Controller-General of the Ministry of Fuel and Power: Dr. H. S. Houldsworth, K.C.

DR. H. S. HOULDSWORTH, K.C., who from January 1, 1944, becomes controller-general of the Ministry of Fuel and Power, graduated in science at the University of Leeds in 1911, taking first-class honours in physics as a student of the late Sir William Bragg. After some years of school-teaching and after the outbreak of war, he entered the Fuel Department of the University on the staff of Prof. J. W. Cobb, the regional deputy inspector of high explosives, visiting works for the sampling and testing of their products. In 1918 with the coming of peace he remained with Prof. Cobb in a newly created post as research assistant on refractory materials, working, and later lecturing, on that subject. In a period of seven years he was joint (or sole) author of a series of papers, mainly for the Ceramic Society, dealing with such matters as the thermal expansion of refractories and the transformations of silica, and although he entered on this work with no special knowledge of the subject, then little studied, he grappled with it effectively and in 1925 was awarded the D.Sc.

Meanwhile Dr. Houldsworth retained and developed an interest in public work in close association with Sir John (now Lord) Simon, the member of Parliament for Spen Valley, and with his encouragement read successfully for the Bar examinations and entered on a new career as barrister. Here he had no long waiting period, but was soon busy, particularly with the coal industry and its multitude of agreements and discussions of one kind and another, in which owners, miners, users and Government authorities were involved. His variety of experience with people differing so widely in training, position and outlook, combined with innate qualities to make him increasingly valued both for sanity of judgment and honesty of purpose. The same qualities have no doubt marked his tenure of office as regional controller of the Ministry of Fuel and Power for the North Eastern Division, to which he was called when the war effort for fuel economy came under Government organization. The extension of his responsibilities now announced will be widely welcomed, particularly by those who have known his work. Typical of his methods was the Yorkshire Fuel Efficiency Committee, for which he secured the effective collaboration of industrial, academic and official representatives and the willing assistance of trained men, in the drive for economy in the industrial uses of fuel.

Government Fuel Research in Great Britain

IN an address to the Institute of Fuel in Newcastle upon Tyne on December 13, Dr. A. Parker, director of fuel research of the Department of Scientific and Industrial Research, surveyed the activities of the Fuel Research Board. To-day, this State organization, with a staff of more than 250, includes the central Fuel Research Station, equipped not only for experiments in the laboratory, but also for experiments on a semi-commercial scale and on a full commercial scale. The full-scale units include plants for cleaning, drying and pulverizing coal, for the manufacture of fuel gases, hydrogen and coke, and there are full-size boilers of several kinds. Experimental work has also been undertaken in co-operation with industry. In addition to the Fuel Research Station, there are nine coal survey laboratories in various parts of England, Scotland and Wales which have been undertaking, in collaboration with the Geological Survey, a comprehensive survey of the qualities of the coal resources of Great Britain. This survey is now being put on a quantitative basis in co-operation with the Coal Commission and the Ministry of Fuel and Power. As a result of this survey, we already have much more information about our coal reserves and the coals on the market than there is about the coals in any other country. Referring to achievements of the fuel research organization, Dr. Parker stated that simple equipment has been developed for fitting to large industrial boilers, which not only greatly reduces the quantity of smoke from the boiler chimney but also increases the efficiency of the coal in raising steam, and work on transport producers using coal and coke in place of petrol for road vehicles, begun at the Fuel Research Station before the War, has led to the introduction of the Government Emergency Producer now in use on many road vehicles. Processes for the production of petrol and other oils and chemicals from coal have received considerable attention at the Fuel Research Station, and a great deal of information has been obtained from experimental work on the distillation of coal, hydrogenation of coal and of tar, and on synthetic methods of producing oils and chemicals from gases made from coal and coke.

Continuing, Dr. Parker said that if Great Britain is to maintain its position in industry, we must rapidly develop our scientific and industrial research in relation to coal and other fuels, in the widest national interest. There must also be a spirit of mutual help in research, involving friendly discussion and collaboration between the scientific men in universities, in Government establishments, industrial research associations, and other research organizations. In relation to fuel in Great Britain, a good beginning in this direction has already been made. The Department has set up a consultative conference on fuel research, which is attended by representatives of the Iron and Steel Industrial Research Council, the British Refractories Research Association, the British Electrical and Allied Industries Research Association, the British Coal Utilization Research Association, the British Hard Coke Research Association, and the Gas Research Board. In his concluding remarks, Dr. Parker issued a note of warning. He said that where there is a lack of the real appreciation of the conditions under which successful research is carried out, there is an impression that if large sums of money are provided for research, marvellous discoveries would follow as a matter of course. While adequate financial provision is naturally essential, it is not in itself enough. The primary requirement is men of the right training and outlook.

Commemoration of the Invention of the Barometer

AT the University of Toronto on October 19, two meetings were held to commemorate the invention of the barometer by Torricelli, three hundred years ago. Last spring, the Canadian Branch of the Royal Meteorological Society decided that this important scientific event should be fittingly commemorated, and invited the Royal Astronomical Society of Canada, the Royal Canadian Institute, and the University of Toronto to join with it in making the arrangements, which were entrusted to a committee under the chairmanship of Mr. W. E. K. Middleton. At the afternoon meeting held in the West Hall of the University College, Prof. C. A. Chant was chairman, and presented to the meeting delegates from the Royal Society of Canada, the American Meteorological Society and the History of Science Society. The first formal paper, entitled "Telescope, Microscope, and Barometer as a Point of Departure for the Natural Sciences", was delivered by Prof. Louis C. Karpinski, of the University of Michigan, president of the History of Science Society, who treated the discovery of the barometer as one phase, and an important one, of the scientific renaissance that took place in the sixteenth century. He was followed by Prof. G. S. Brett, of the University of Toronto, who dealt with the remarkable effect of the discovery on contemporary thought, particularly as it affected the relations between science and theology, and the ideas of the structure and properties of matter.

The evening meeting was held in the McLennan Laboratory of the University of Toronto, under the chairmanship of Dr. J. Patterson, controller of the Canadian Meteorological Service, who opened the proceedings by repeating the Toricellian experiment before a large audience. Mr. W. E. K. Middleton, of the Meteorological Office, then gave an illustrated lecture on the subsequent history of the barometer, showing many slides of interesting instruments developed throughout the past three hundred years. Finally, Prof. John Satterly, of the University of Toronto, presented a paper on the applications of the barometer in physics and chemistry, and emphasized the need for considerable precision when the barometer is used in physical research. It is hoped to publish these papers in the *Journal of the Royal Astronomical Society of Canada*.

The Chinese Medical Journal

The reappearance of the *Chinese Medical Journal*, the publication of which, says the *Lancet* (559, Oct. 30, 1943), was suspended by the occupation by the Japanese of the Chinese Medical Association's offices, coincides with the publication of a book by one of the editors of the *Journal*, Dr. Szeming Sze, entitled "China's Health Problems". Dr. Sze, who was educated at an English public school, at the University of Cambridge and at St. Thomas's Hospital, is also general secretary of the Chinese Medical Association, which now has offices at Washington, the address of which is P.O. 6096. Reviewing Dr. Sze's book, the *British Medical Journal* (580, Nov. 6, 1943) indicates the magnitude of China's health problems. The morbidity-rate is 4 per cent of the population, which means that, in any one day, about 16 million people are ill in China. To treat these there are, in the whole country, 12,000 doctors and 38,000 hospital beds. The usual medical standards require that there should be at least 266,000 doctors and 2 million hospital beds. As things are, many Chinese people still rely exclusively on native methods of treatment. Anyone who is interested in one aspect of these should read the article on Chinese Anthelmintic Prescriptions from the Han period (about 217 A.D.) to the present time (1940) by C. S. Chao, in the *Chinese Medical Journal* (57, 251–289; 1940).

It is proposed to publish the *Chinese Medical Journal* quarterly from the United States until the end of the War, and at the same time to issue from Chungking a medical digest in the Chinese language. The other editor of the *Journal* is Dr. J. Heng Liu. The first issue of the newly published *Journal* includes accounts of typhus fever in Kunming and Shanghai, and articles on malaria, cholera and plague. The work of the Weishengshu Anti-epidemic Corps, which sends mobile units from Chungking all over free China, is described. It is stated that Japanese aeroplanes dropped parcels of grain and rags, containing plague-infected fleas, over Changteh in November 1941; a few days later bubonic plague broke out in the city. News is also given of various agencies and relief organizations now at work in China. The Henry Lester Institute at Shanghai is still active, but its director is now Japanese. The Peking Union Medical College and Hospital are, however, closed and their director, Dr. H. S. Houghton, has been interned.

Train Orders by Facsimile Telegraphy

Facsimile telegraphy is one of the devices recently called upon by the railways to help meet the unprecedented demands of to-day. It has many advantages over other forms of communication for several railway applications. For example, its inherent accuracy makes it an ideal method for the handling of train orders and once the order is prepared for transmission it need never again be copied manually. The possibility of transmission error is greatly reduced by the fact that the method can operate through extremely high levels of interference. Simplicity of operation and the ease with which duplicate copies may be secured are additional advantages. Automatic recorders, housed in small shacks along the right-of-way, are located at sidings, branches, crossings—wherever a train might be required to stop. Recorders may also be installed in small stations where telegraph service is not provided. An automatic transmitter, under control of the operator for the district, is arranged so that he may transmit orders to any of these recorders.

Since the recorders are entirely automatic, the order may be transmitted in advance of the arrival of the train. The circuit is arranged so that the transmitter may be set by the operator to send automatically as many copies of the order as are required by the various members of the train crew, and the orders are thus secured with a minimum of time and effort. The time and effort required of the operator are equally slight; he dials the desired recorder, sets an indicator to the desired number of copies, and drops the order into the machine. The messages simply roll out of the machine into a receptacle whether or not there is anyone present to receive them. A recorder readily adapted to such service was developed by the Western Union Telegraph Company for use in conjunction with automatic transmitters, and the equipment comprises what is probably the most completely automatic telegraph system yet devised. An article by J. H. Hackenberg (*Elec. Comm.*, 21, No. 2; 1943) describes and illustrates the new equipment and its mode of operation.

A South American Review of Newton's Work

In a paper entitled "El Tricentenario De Newton", Mario Bunge examines five different aspects of Newton's work (Buenos Aires: Universidad Obrera Argentina Instituto Cientifico, Seminario De Filosofia, November 1942. Pp. 8). The first of these is his discovery and application of the infinitesimal calculus, a discovery which unfortunately caused some unpleasant feeling with Leibniz, though, as is pointed out, each represented a distinct school so that their contributions can be regarded as complementary.

Secondly, Newton was responsible for the introduction of the deductive method in the natural sciences and so rendered signal service to mankind as the founder of mathematical physics, which has been the basis of so much in science for two and a half centuries. Then, his rational mechanics had a profound influence for many generations. Newton's differential equations showed how the state of the universe today is the result of all its past history, and its future history could be determined by its present. This required a strict determinism which obsessed the minds of men of science for a long period, though in comparatively recent times there has been a strong reaction against it. His work on optics showed his ability as an experimental physicist. Newton's subordination of optics to mechanics, far from enhancing progress, was a principal cause of the lack of progress in optics during the eighteenth century. An ironical result of his experiments with diffraction and interference was the death-knell a century later of his corpuscular theory of light. Lastly, Newton's philosophical work must not be forgotten. Space and time were objective and independent of our perception of them, according to Newton, and were not *a priori* representations which served for the foundations of all external intuitions. Force, energy, mass, motion, as well as space and time, were all objective entities for Newton. His work must be considered a model of the systematic application of scientific method—a model of the power of reason to investigate the natural, controlling and ruling it, by placing it at the service of progress, material, cultural and moral, of humanity.

Earthquakes Recorded during September

THE U.S. Coast and Geodetic Survey has determined the epicentres of six earthquakes occurring between Sept. 5 and 20. The first was on Sept. 5 from lat. 0° long. 125° E., which is in the Molucca Passage east of the island of Celebes in the East Indies; time at origin, 8h. 34·8m. The second was on Sept. 6 from an epicentre lat. 53·2° S. long. 159·4° E., which is north-east of the Macquarie Islands, south-west of New Zealand; time at origin, 3h. 41·5m. The third was on Sept. 10 from an epicentre lat. 18·9° N. long. 67° W., which is near the north-west coast of Porto Rico in the West Indies, time at origin being 2h. 31·6m. The fourth was also on Sept. 10, from an epicentre near lat. 35·1° N. long. 133·3° E., which is in the Pacific Ocean west of California, time at origin being 8h. 36·9m. The fifth was on Sept. 11, from an epicentre near lat. 16½° S. long. 173° W., which is in the Pacific Ocean between Samoa and the Friendly Islands and east of Fiji. Time at origin was 19h. 34m. The sixth was on Sept. 20 from an epicentre near lat. 19½° N. long. 109° W., which is in the Pacific Ocean west of Mexico and north-east of Revilla Gigedo Island. Time at origin was 00h. 53·7m.

Earthquakes were registered at Kew on Sept. 5 at 08h. 49m. 11s. from an epicentre 12,000 km. distant; on Sept. 6 at 04h. 01m. 32s. from an epicentre 18,700 km. distant (maximum amplitude at Kew 440 μ); and on Sept. 10 at 08h. 49m. 32s. from an epicentre 9,560 km. distant (maximum amplitude 250 μ at Kew). All times are in Universal Time and interpretations and calculations are provisional.

On October 26 an earthquake was felt in San Francisco. Some telephones were put out of action, some windows broken and some articles jolted off shelves.

Announcements

THE title of professor of technical optics in the University of London has been conferred on Dr. L. C. Martin in respect of the post held by him at the Imperial College of Science and Technology.

THE University of Oxford has accepted an offer from the Lord Nuffield Provincial Hospitals Trust of £8,000 a year for research in plastic surgery and for training in that branch of surgery.

DURING 1943 the Royal Society of South Africa elected the following fellows: John G. Rose, formerly Government analyst and chief chemist to the S.A. Railways and Harbours, Cape Town, for his valuable applications of chemistry in the field of engineering; and Hillel A. Shapiro, assistant Government pathologist, Cape Town, for his work on experimental physiology and malnutrition. The Abbé Henri E. P. Breuil, the distinguished archæologist, at present attached to the University of the Witwatersrand, Johannesburg, has been elected an honorary fellow of the Society.

THE Charles L. Mayer Award for 1943 will be made by the National Science Fund of the U.S. National Academy of Sciences for an outstanding contribution to present-day knowledge of factors affecting the growth of animal cells, with particular reference to human cancer. In addition, the advisory committee requests recommendations from scientific men of persons whose present work is in this field and who are achieving outstanding results. The closing date for the receipt of manuscripts and published articles is January 15, 1944; they should be sent to the National Science Fund of the National Academy of Sciences, 515 Madison Avenue, New York 22, N.Y.

MESSRS. H. K. LEWIS AND CO., LTD., 136 Gower Street, London, W.C.1, have issued a price list of certain German publications which are being reproduced in the United States by photo-offset process under authorization of the Alien Property Custodian in Washington. It includes books on mathematics, physics and chemistry, mainly published during the period 1930–40; among the titles are many standard works of references, as well as recent technical books. Messrs. Lewis are accepting orders, but anticipate a delay of three months in obtaining copies.

SIX popular lectures on astronomy have been arranged by the Royal Astronomical Society and the British Astronomical Association, and are being given on Fridays at the Royal Astronomical Society's rooms in Burlington House, Piccadilly, London, W.1, for members of the British and Allied Forces. The first was given on December 3 by Sir James Jeans on "Photographic Astronomy". On December 17 Prof. W. M. Smart is speaking on "The Origin of the Earth". Succeeding lectures will be given on January 7, by Mr. B. M. Peek, on "The Planets and Planetary Observations"; on January 21, by Prof. H. Dingle, on "The Movements of the Stars"; on February 4, by Mr. Will T. Hay, on "Life on other Planets"; and on February 18, by Mr. F. J. Hargreaves, on "The Determination of Stellar Distances" The lectures begin at 6.30 p.m. Admission is free by tickets obtainable from Service Organizations or from the Assistant Secretary, Royal Astronomical Society, Burlington House, Piccadilly, London, W.1

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Non-Solar Planetary Systems

In discussing the significance of the two planet-like bodies which are now supposed to revolve around 61 Cygni and 70 Ophiuchi, Mr. Sen writes[1] that "we find that there can be at most two planetary systems in the galactic system, on Jeans's theory". If the true number were two, or anything like two, it would, of course, be out of the question to suppose that there could be three planetary systems so near to us in space. But I do not think that the true number is anywhere near to two; in a recent letter in NATURE[2], I calculated that something like one star in six might well be accompanied by planets, in which case the number of galactic planetary systems would not be two, but some tens of thousands of millions. There is no reason why 61 Cygni and 70 Ophiuchi should not be two out of these millions of systems, so that I think that Mr. Sen's argument against my tidal theory fails.

Mr. Sen refers with approval to Banerji's modification of this theory. This makes the original sun a Cepheid which had its oscillatory instability increased by the gravitational attraction of a passing star. But a passing star cannot increase the instability of a Cepheid appreciably unless it comes very near; and as a very near approach can do all that is needed with *any* star, why introduce the added complication of supposing the star to be a Cepheid? Judging by their luminosity, all Cepheids are much more massive than the sun or 61 Cygni or 70 Ophiuchi, although, of course, this may not have been so in the remote past.

I cannot see that the discovery of the new planet-like bodies affects the present tidal theory in any way, except that, if we interpret them as true planets, they may perhaps give some slight support to my calculation[3] as to the frequency of planetary systems in space.

J. H. JEANS.

Lodge Hill House,
Westbury-sub-Mendip, Wells.

[1] NATURE, 152, 600 (1943).

[2] NATURE, 149, 695 (1942).

[3] *loc. cit.*

Non-Solar Planets and the Origin of the Solar System

THE discovery of two non-solar planets[1-3] makes it possible to check theories of the origin of the solar system.

Some time ago I pointed out that the motion of ionized matter even at the distance of the planets from the sun is affected very much more by the sun's general magnetic field than by solar gravitation, and that consequently this magnetic field may have been of fundamental importance at the genesis of the solar system[4]. A theory was put forward according to which the planets were formed of matter falling in from interstellar space towards the sun, and stopped by the action of the sun's magnetic field as soon as it became ionized by the heating due to gravitation. The theory requires that the main part of the matter become accumulated at that distance r from the sun (mass $= M_{\odot}$) where the gravitational energy equals the ionization energy eV_{ion}. Thus we have:

$$\frac{M_{\odot}m}{r} = eV_{\text{ion}}, \qquad (1)$$

where m is the mean atomic weight of the gas. The distance r equals the orbital radius of Jupiter if $V_{\text{ion}} = 12$ volts and $m = 7$ (or, through a certain correction, $m = 10$), which values are quite reasonable.

When Jupiter's mass is substituted for the solar mass in (1), r becomes equal to the distance of the large Jovian satellites, which indicates that they may have been generated in the same way as the planets. The structure of the Saturnian system also is consistent with the theory.

The invading matter probably originated from a gas cloud once surrounding the sun. If other stars have been surrounded by clouds of the same mean atomic weight, they are likely to possess similar planetary systems, the dimensions of which are proportional to the masses of the stars. Thus the 'Jupiter' of a star with the mass M (sun $= 1$) will have the orbital radius

$$r = 5{\cdot}2\,M \text{ astron. units.}$$

Observations have not determined to which components of the double stars the newly discovered non-solar planets belong. My theory requires that for a given cloud density the larger component shall have the more massive planetary system. As the components of 61 Cygni are almost equal, the largest planets of each of them should have almost the same masses and periods, so that the observed disturbance is due to both of them. For 70 Ophiuchi a planet of the larger component ought to produce the greatest effect. Thus we find:

Star	Mass	Distance of planet	
		Theory	Obs.
61 Cygni[2]	0·56	2·9	2·4
70 Ophiuchi[3]	1·1	5·7	6·8

The agreement indicates that these non-solar planets may have been formed in the same way as our planetary system.

The theory makes it probable that all stars are surrounded by planetary systems (more or less massive) of the same structure as ours. Planets corresponding to Jupiter will have the period

$$T = 11{\cdot}9\,M \text{ years.}$$

It may be worth while to look for disturbances with such periods.

H. ALFVÉN.

Kungl. Tekniska Högskolan,
Stockholm. Nov. 3.

[1] Hunter, A., NATURE, 152, 66 (1943).

[2] Strand, K. A., *Pub. Ast. Soc. Pac.*, **55**, 29 (1943).

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Mutation and the Rhesus Reaction

RECENT announcements by Race, Taylor[1,2] and their collaborators in these columns, and by Wiener and Landsteiner[3], elsewhere, are of peculiar interest in connexion with some genetic implications of Levine's interpretation of erythroblastosis. Levine's hypothesis postulates a form of adverse selection restricted to heterozygous offspring of a particular class of matings and not usually affecting first-born. Selection intensity therefore depends both on the frequency of the gene *rh* and on the size of the family. During the summer I made an examination of the theoretical consequences of these assumptions. The results, submitted for publication in full elsewhere, led to two conclusions: (*a*) the likelihood that *Rh*(+) is the manifestation of several dominant alleles of a multiple allele series in conformity with experimental data since then established; (*b*) the possibility that all such alleles are not equally efficacious with reference to the determination of hæmolytic anæmias of the newborn or stillbirths and miscarriages associated therewith.

From a theoretical point of view the outstanding anomaly of Levine's hypothesis is the very high incidence of a gene subject to fairly intense adverse selection. If μ is the net mutation-rate to a recessive gene of frequency r from one or more dominant alleles, s being the negative coefficient of selection for the heterozygous class as a whole, the condition of equilibrium between mutation and mortality is given by the relation:

$$\mu = \frac{sr(1-2r)}{1-sr}.$$

Various considerations, including remarkably close correspondence between figures for incidence of *Rh*(−) based on samples collected from widely separated localities, justify the supposition that an equilibrium state exists. On the basis of available vital statistics with respect to general incidence of erythroblastosis and the proportion of stillbirths or miscarriages attributable to the same mechanism, we may assign a lower limit to s. We then find that μ is much higher than any single-gene mutation-rate as yet recorded in the laboratory or in the field. On the other hand, its value is not inordinately high if we interpret μ to signify the rate of mutation at the *rh* locus from *any one of a series* of 5 or more dominant alleles. Conclusions at which Wiener and Landsteiner in America and Race, Taylor *et al.* in Great Britain have independently arrived at from observation, thus tally with what one would have strong grounds for assuming to be true from purely theoretical considerations.

What is more important in connexion with further work is that the distribution defined by the equilibrium condition stated above may depart very considerably from a random distribution calculated on the assumption that selection and mutation are negligible. The appropriate equations for gene frequency analysis must therefore make μ and s explicit. They are quite straightforward, if we know s. At present, there are insufficient reliable statistics of the general incidence of erythroblastosis fœtalis or of the fœtal and neonatal mortality associated with it. By the same token there are insufficient data for evaluating precisely what contribution isoimmunization makes to the etiology of erythroblastosis fœtalis. What is certain in the light of statistics already to hand is that second or later born heterozygous offspring of *Rh*(−) mothers by *Rh*(+) fathers are far more numerous than recognizable cases of neonatal hæmolytic anæmia and associated miscarriages or stillbirths.

It is therefore pertinent to emphasize a consideration insufficiently realized by workers in the clinical field. Where the end in view is to assay the importance of serological incompatibilities as agencies contributory to fœtal and neonatal mortality, samples collected because of recorded erythroblastosis within a fraternity, and afterwards tested for the blood grouping of parents and offspring or for the anti-body titre of the mother, may be misleading. We should proceed from the opposite direction, that is, collect *entirely random* samples of offspring by parents of particular blood groups in order to determine the incidence of erythroblastosis, stillbirths and miscarriages, together with the blood groups of the offspring. Large enough samples both of matings *Rh*(+) father by *Rh*(−) mother and (as a control group) *Rh*(+) mother by *Rh*(−) father, should then give us all essential data for a just appreciation of the value of Levine's hypothesis and all relevant data for a determination both of the mutation-rate (μ) at a human locus and of the selection coefficient (s) of the *rh*–*Rh* system. Under war-time conditions, the possibility of getting such samples at blood transfusion depots is not fanciful.

LANCELOT HOGBEN.

Department of Zoology,
University of Birmingham.
Nov. 14.

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[2] Race, Taylor, Boorman and Dodd, NATURE, 152, 563 (1943).

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An Interferometric Procedure for the Examination of Crystal Surfaces

THE accompanying photographs illustrate a high-precision interference procedure which has been developed for the examination of the contours of the surface figure on the surfaces of crystals. The method employed is an adaptation of Fabry and Perot's modification (made in 1897) of Fizeau's standard method for examining the perfection of optical flats with localized fringes. It is essentially a multiple beam interference procedure, depending for its precision on the employment of many interfering beams, and is easiest to apply to reasonably large crystalline surfaces which are moderately plane.

A transmitting high-reflecting coefficient thin silver film (reflecting coefficient about 0·85) is deposited upon the untouched crystal face by evaporation *in vacuo*. This silvered surface is then adjusted to be nearly parallel to a similarly coated good optical flat. The separation between the silvered surfaces is preferably a small fraction of a millimetre, but the actual value is not critical. A parallel beam of light from a small circular aperture illuminated by a green-filtered mercury arc is directed at normal incidence on to the silvered faces. Fringes of equal thickness form; but owing to the multiple reflexions these are extremely sharp and have an intensity distribution depending upon the reflecting coefficient in a manner identical with that of the normal circular Fabry-Perot fringes of equal inclination.

These localized fringes constitute true contour lines of the crystal surface if the optical flat is of very high precision, and the interval between a pair of fringes represents a change in surface height of half a wave. The method has been applied to the examination of the cleavage surfaces of mica, selenite and calcite, and also to a natural surface of a quartz crystal. Some striking facts have thus been revealed. Typical contours of mica and selenite are shown in the accompanying reproductions.

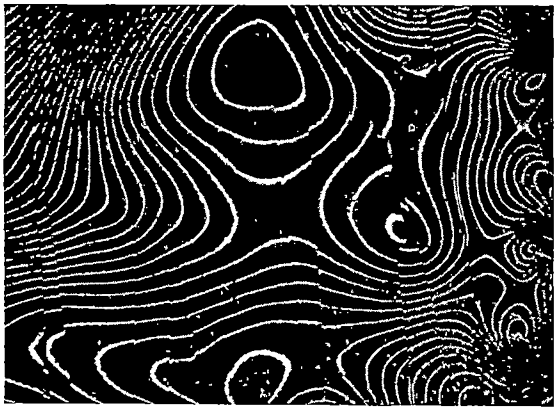

Fig. 1. MICA.

Fig. 1 shows a typical mica cleavage surface, the rea represented being about one square centimetre. ll mica surfaces so far examined reveal similar atterns. The highly advantageous intensity disribution is clearly evident. The fringes are very harp narrow lines, occupying a small fraction of the istance between orders. The strong fringes are due o the green mercury line, the weaker doublet being he yellow lines. These permit identification of orders o be unambiguous. Without going into the finer points f detail, three main features are apparent: (1) The eneral contour of the hills and dales on the surface rendered with startling clarity. (2) Sharp cleavage oundary lines appear. These represent steps of, in ost cases, a fraction of a wave-length. The smallest tep so far recorded is 40 A., which is only a few olecules. (3) The areas between the cleavage oundary lines may pass over hills and dales, but hey are highly uniform, as evidenced by the smoothess of the fringes within the separate areas.

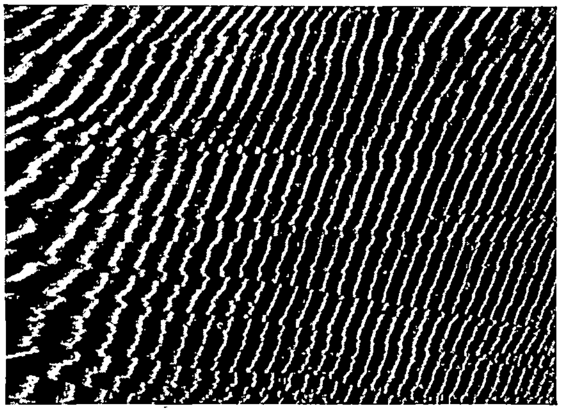

Fig. 2. SELENITE.

Fig. 2 shows in contrast a typical contour pattern or a good cleavage face of a crystal of selenite. he obvious characteristics are: (1) Absence of bigcale hills and dales as exhibited by mica. (2) Cleavge boundary lines all in the same general direction. 3) The fringes are nowhere smooth and continuous, ut are quite ragged. Examination by high dispersion hows that the ragged feature originates in the fact hat the surface exhibits a very large number of small acets differing in height by a small fraction of a ave-length.

It is clear that this experimental procedure has onsiderable potentialities in revealing the finer details of the surface structure of crystals. The highly sharpened fringes permit of very great precision, and cleavage steps of the order of but a few molecules thick can be detected and measured. This is, of course, far beyond the range of the microscope. A step only 30 A. in height could be detected.

Further details of procedure and specific results relating to mica, selenite, calcite and quartz will be communicated elsewhere.

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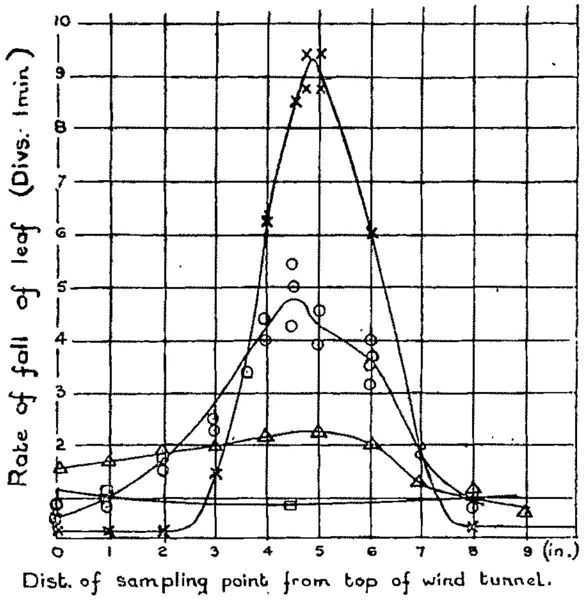
Nov. 18.

Use of Radon to Trace the Flow Pattern of Gases in Furnaces

IN the operation of furnaces, the mean mixing length, l, of the gases[1] is of importance (as it is in aircraft design) since the processes of combustion, heat transfer, and of reaction with the surface being heated depend very largely upon the mass transfer of gas in directions normal to the main flow. The method of calculating l from observations of the temperature distribution in the wake of a hot wire is inapplicable for furnaces, and most chemical methods are also precluded by the relatively high temperatures and the impurities present. The use of a radioactive gas, on the other hand, offers a method which is not subject to these difficulties, since the activity is unaffected by temperature and by chemical reactions.

A series of experiments carried out in a home-made wind tunnel (cross-section 25 cm. × 25 cm.) has shown that the method is quite practicable. A 20 millicurie sample of radon was mixed with air in a gas-holder of about 350 litres capacity, and the mixture injected at 0·15 litres/min. into the centre of the main air stream, the volume-rate of which was 4,000 litres per min. The aperture was of such size as to give the radon-air about the same linear velocity as the main stream. Samples of the gas were drawn off through probe tubes placed at various distances and positions downstream. The samples were drawn through a tower containing cotton-wool and calcium chloride, and then passed into the chamber of an inverted Rutherford-type emanation electroscope which was alternately charged and evacuated several times. The top of the chamber was then removed and a standard Ministry of Food tin, with lid bored to fit over the insulator, inserted, a fresh tin being used for each reading. In this way the effect of recoil atoms was made negligible and a very low natural leak obtained (approx. 0·17 div./min.). Curves obtained with this apparatus are reproduced, the abscissa being the vertical height of the probe point in the tunnel, and the ordinate the relative activity of the sample in scale divisions per minute. It will be seen that the curves corresponding to sampling planes near the inlet point, where the effect of the walls is small, obey the Gaussian error law sufficiently well to be used for calculation of the mean mixing length. The relative spread (½ value width) and relative maxima of the curves also show the expected order of agreement with theory.

These results were considered to justify the attempt to apply the method to furnace systems, and preliminary trials have accordingly been made in a glass-melting furnace which have shown that no unexpected difficulties arise. The method can be used



DISTRIBUTION OF RADON IN THE WAKE OF A POINT SOURCE. SAMPLING PROBE AT POSITION 1A, × ; AT 2, ⊙ ; AT 3, △ ; AT 6, □.

not only for measurements of l but also of the cross flow from one furnace port to another. By introducing the active gas suddenly it can be used for the detection of regions of very low gas velocity; and by measuring the relative activity in a single pipe after perfect mixing is attained, it can be used for metering hot raw gases continuously—a technical problem of very great difficulty and importance.

It is proposed to improve the technique by the use of an electrometer valve to increase the convenience of measurement for field work, and possibly by the development of continuous methods of removing the recoil atoms.

Our thanks are due to Dr. N. Feather, Prof. S. Russ and Mr. R. Siday for advice on the radioactive technique, and Mr. P. R. Chase for carrying out much of the experimental work; also to the Medical Research Council for the radon used in these experiments.

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A New Water-Soluble Polysaccharide from Perennial Rye Grass Pasture

A WATER-SOLUBLE polysaccharide containing galactose and glucose residues has been isolated from perennial rye grass pasture. Repeated fractional precipitation from aqueous solution by alcohol and acid-alcohol followed by prolonged dialysis did not effect appreciable reduction of the high ash content (more than 30 per cent) of the polysaccharide. Since the ash consisted of calcium sulphate, it is suggested that the polysaccharide may occur as the calcium salt of the sulphuric ester of a polygalactose with one or more glucose residues incorporated in the carbohydrate moiety.

The aqueous solution of the polysaccharide was neutral in reaction, reduced Fehling's solution, an gave a positive rotation, $[\alpha]_D^{16°} + 40°$ ($C = 0{\cdot}125$)

The galactose was identified as mucic acid, m.p and mixed m.p. 214° C., and the glucose as aci potassium saccharate, which was converted to th silver salt. No other sugars were found.

All previously reported galactans appear to be o algal or fungal origin and the few known poly saccharide sulphuric esters, for example, agar fucoidin[2], etc., have been extracted from the sam sources. On the other hand, the polysaccharid herein described is of higher plant origin.

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Canterbury University College,
Christchurch, C.1,
New Zealand.
Aug. 18.

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[1] Jones, W. G. M., and Peat, S., *J. Chem. Soc.*, 225 (1942).

[2] Bird, G. M., and Haas, P., *Biochem. J.*, **25**, 403 (1931).

Microbiological Assay of Riboflavin

IN his letter appearing under the above title[1], D F. C. Happold criticizes the procedure used by D E. C. Barton-Wright and Mr. R. G. Booth[2] in th determination of riboflavin, and insists on the impor ance of calcium in the nutrient medium and mention the work of Chattaway, Happold and Sandford[3]. Th evidence in the latter paper to which he evidentl refers consists in an experiment in which a series increasing doses of calcium chloride was added to th nutrient medium. The authors do not seem to hav appreciated fully a limiting factor in the very lo solubility of calcium in the presence of excess phosphate at pH 6·6–6·8. The solubility product tricalcium phosphate is about 10^{-32}, but may be pe haps 10^{-31} in the presence of the other minerals co tained in Chattaway, Happold and Sandford nutrient medium[4,5].

Calculation shows that the quantity of calciu soluble under the conditions of their experiment the equivalent of 0·0028 ml. of 0·5 per cent calciu chloride in the 20 ml. of medium used, where additions ranging from 0·1 to 0·8 ml. were mad Virtually the whole of the added calcium would precipitated. It is true that the addition of calciu chloride was delayed until after sterilization of t main part of the medium, but subsequent precipit tion during the seventy-two hours at 37° may taken as certain. In the absence of precise knowled of certain factors—the time taken for such precipit tion to occur, how soon inoculation followed the pr paration of the flasks of medium, whether or n precipitation preceded the main growth of t bacteria, and if so its effect on the latter when settli to the bottom of the flasks, etc.—it is impossible state what effects were exercised by the add calcium. At least it seems certain that the dire conclusion that calcium stimulates growth of t Lactobacillus is not warranted by the experiment evidence cited.

R. H. HOPKINS.

University of Birmingham.
Nov. 8.

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A Penicillin-like Substance from *Aspergillus giganteus* Wehm.

THE production of antibiotic substances by several species of Aspergillus has been reported, and several have been purified or isolated[1–5]. Wilkins and Harris[6] described the production of a substance, active against staphylococci, by *Aspergillus giganteus*. A culture of the mould (kindly supplied by Dr. Wilkins) was grown on a medium consisting of malt extract, 2 per cent, peptone, 1 per cent, *M* triethanolamine buffer *p*H 8·2, 5 per cent. The antibiotic has been purified and a crystalline degradation product prepared. In all its chemical and biological properties it appears to be very similar to penicillin[7].

Although the mould produces much less pigment than *Penicillium notatum*, the yield of the antibiotic is lower and the purification no easier than that of penicillin.

It is suggested that this substance be called *gigantic acid* to indicate its source.

It is of interest that the production of antibiotics chemically similar to penicillin is not limited to the genus Penicillium, but that they are produced by at least two species of Aspergillus, namely, *Aspergillus giganteus* and *Aspergillus flavus*[3,4].

Full details of this work will be published when publication conditions permit. I am indebted to the Agricultural Research Council for a personal grant.

FLORA J. PHILPOT.
Sir William Dunn School of Pathology,
University of Oxford. Nov. 10.

[1] White, E. C., *Science*, 92, 127 (1940).

[2] Waksman, S. A., Horning, E. S., and Spencer, E. L., *Science*, 96, 202 (1942).

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[4] McKee, C. M., and MacPhillamy, H. B., *Proc. Soc. Exp. Biol. Med.*, 53, 245 (1943).

[5] Glister, G. A., NATURE, 148, 470 (1941).

[6] Wilkins, W. H., and Harris, G. C. M., *Brit. J. Exp. Path.*, 23, 166 (1942).

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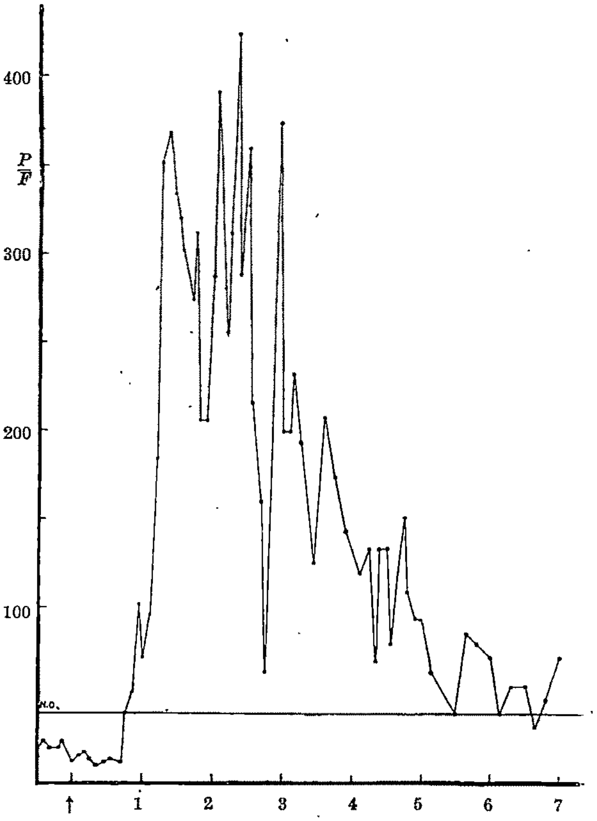
Lipæmogenic Activity of Pituitary Extracts

Frazer and Stewart[1,2] have described the chylomicron count method for assessing the level of blood-fat, and have used it to follow the effects of starvation and standard meals in man. Stewart[3], using this method, has also observed lipæmias in rabbits after severe hæmorrhage.

In the course of some experiments on rabbits we have noticed that lipæmias have frequently followed the subcutaneous injection of certain extracts prepared from pituitary glands. The work has now been discontinued, at any rate for the time being, but we have thought it worth while briefly to record our own observations as to the frequency with which these lipæmias occur and the courses they run.

The most striking feature is the extreme variation in their intensity. Thus, 27 rabbits were injected with the same amount of a pituitary extract; 4 showed no lipæmia, 21 gave maximum chylomicron counts between 5 and 10 times the normal, while 2 animals developed lipæmias so intense that they were visible to the naked eye, the particles being too densely packed to be counted. The accompanying figure illustrates the characteristic course of the lipæmia in one rabbit. Counts were made every five minutes for four hours following the injection, then at ten-minute intervals for one hour and again at five-minute intervals for a further two hours. Whenever the lipæmia could be assessed by this method, that is, in the 21 rabbits mentioned, it began between forty and fifty minutes after injection and rose rapidly to a maximum during the next thirty minutes. In animals giving the higher counts the lipæmia was sustained for an hour: there followed a general decline in count such that normal values were reached five hours after the injection, though transitory small increases occurred during the fall and for a further two hours.



$\frac{P}{F}$ = particles per microscope field; † indicates time of injection; *N.C.*, average pre-injection 5 mm. chylomicron count of 21 starved rabbits.

Marked fluctuations in the chylomicron count occurred throughout the period of observation; it was, however, noticed that the ascending portions of the curve were invariably steeper than the descending, especially during the period of maximum lipæmia. We incline to the view that this phenomenon occurs because the particles are injected into the circulation through the thoracic duct. Further, the general course of the curves suggests that fat is entering the circulation by this route for at least one hour after the initial rise.

The extracts used were prepared from desiccated frozen whole sheep pituitaries. They were good sources of thyrotrophin and gonadotrophin, but had been substantially freed of prolactin, containing less than 5 per cent of the quantity extractable from the equivalent weight of dried gland. The extracts also showed appreciable pressor and oxytocic activities.

The extracts were further found to be a potent source of the factor that raises the liver-fat content of adult guinea pigs. Control extracts prepared from sheep muscle raised neither the fat content of guinea pig livers nor the chylomicron count of rabbit blood. We therefore regard the experiments reported here as evidence for the view that these two effects may be brought about by the same pituitary factors.

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[1] Frazer, A. C., and Stewart, H. C., *J. Physiol.*, **90**, 18 (1937).

[2] Frazer, A. C., Stewart, H. C., and Elkes, J., *J. Physiol.*, **95**, 68 (1939).

[3] Stewart, H. C., *J. Physiol.*, **101**, *Proc.* (1942).

Binocular Focusing on a Repeating Pattern

SOME correspondence appeared in NATURE in 1938 about the phenomenon described by Brewster[1], which is obtained by focusing on a surface covered by a repeating pattern while converging on a point nearer than, or beyond it, so that the images of different units of the pattern fall on corresponding points of the two retinæ. Paget[2] found that when he converged, the patterned surface seemed to approach to the position of the point of convergence, the units appearing correspondingly smaller. This experiment has now been tried on eight subjects, and Paget's result only obtained with four of them. They were asked to estimate, and then indicate with a ruler, the distance and size of the pattern. Two saw the images at the distance for which they were focusing, however much they squinted, and two saw them in a rather indeterminate intermediate position.

The divergent results of previous investigators of the factors underlying judgments of absolute distance seem to be due partly to differences in their experimental methods, and partly to the very limited number of subjects studied. It can be shown by using only a tiled floor or striped wallpaper, a tape-measure, and a piece of thread, that the estimate of absolute distance can vary widely with the subject and the conditions of the experiment. A satisfactory arrangement for such an experiment must provide that: (1) the illumination is constant; (2) the size of the retinal image is constant; (3) the object to be observed can be clearly focused; (4) the object fills the whole visual field so that there is nothing else with which to compare it; (5) the distance of the 'marker' used to indicate the position of the image can be accurately judged; (6) the 'marker' is not visible until the position of the image has been judged, otherwise estimates are purely relative. The apparatus of Carr and Swenson[3] neglects point 3, that of Grant[4] point 5, and that of Fischer and Löwenbach[5] points 4 and 6.

The repeating pattern fulfils all these requirements; the difficulty arises in choosing a suitable 'marker'. If a piece of thread was used, the apparent position of the pattern varied according to whether the thread ran sagittally or from right to left. In the latter case, when the thread could only be located by focusing, two of the subjects could not tell where it or the images were; but all who could make a judgment in both sets of conditions located the images nearer the point of convergence with the thread running sagittally, and therefore easy to converge upon. The two 'focusers' still saw the pattern well beyond the point of convergence. When one of the 'intermediate' subjects, who usually located the image not far from the plane on which he was focusing, held the thread sagittally at the point of convergence, he found that the pattern "floated up and sat on it", dropping down again when he removed the thread. An apparatus which uses as a 'marker' a vertical rod visible all the time therefore begs the question. The type of pattern used also affects the results; the two subjects who tested this point located vertical lines nearer the eye than a diagonal grid.

When the subjects were given a rough test for their stereoscopic acuity, their quickness and accuracy varied directly with the degree to which they used convergence for assessing distance. Variation in the observers and in the type of floating mark or grid used in the apparatus may be of importance in the interpretation of air photographs.

In my view, contrary to most recent opinion, fine stereoscopic discrimination, in some people, does depend on small changes of convergence. It is hoped to make some more refined experiments to investigate this point.

NELLIE HENDERSON.

King's College,
Newcastle upon Tyne. Nov. 18.

[1] Brewster, D., *Phil. Mag.*, **30**, 305 (1847).

[2] Paget, Sir R. A. S., NATURE, **142**, 77 (1938).

[3] Swenson, H. A., *J. Gen. Psychol.*, **7**, 360 (1932).

[4] Grant, V. W., *J. Exp. Psychol.*, **31**, 89 (1942).

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J. B. Hannay and the Artificial Production of Diamonds

IT seems to be a well-established fact that Hannay did make diamonds, and as the result of an investigation which, in my memoir[1] of him, I described as difficult, and carried out in a masterly manner. That work like this would be scoffed at, and the mere evidence that could be put forward at the time discounted, was to be expected. It will be remembered that, when the discovery of argon was first announced, there were plenty of critics ready to suggest that the announcement was made on altogether insufficient evidence, and to commit themselves to observations which no one would attempt to justify to-day.

It seems to me to be unfortunate that an attempt should be made[2] to justify Hannay's critics, rather than to find in his other investigations evidence that he really was no mere inventor, but a very clever investigator, who came to his discovery as the result of clear reasoning, followed by well-planned and boldly executed experiments. No one who has read his papers on the continuity of the gaseous and liquid states can fail to come to such a conclusion; and many of his minor investigations show insight and exceptional experimental skill.

Now there is a very definite reason why Hannay did not reply to the criticism to which Lord Rayleigh refers. In the middle 'eighties, before he was thirty years old, Hannay had entirely abandoned what may be termed academic experimental work, and thrown himself into industrial research. What he did, he put his whole heart into; and if the criticism came to his notice, it is scarcely to be imagined that it would interest him.

However, why should Hannay 'fake' a result of this kind? The letter from Ramsay to McGowan, which I publish in my memoir, shows that Hannay not only used but also made the apparatus referred to. The general experience is that errors of this kind are accidental; and as a matter of experience, we all make mistakes, even the youngest of us.

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[1] *Chem. and Ind.*, **17**, 507 (1939).

[2] NATURE, **152**, 597 (1943).

SUBDIVISION OF INSECTA PTERYGOTA INTO SUBORDINATE GROUPS

By Dr. B. N. SCHWANWITSCH
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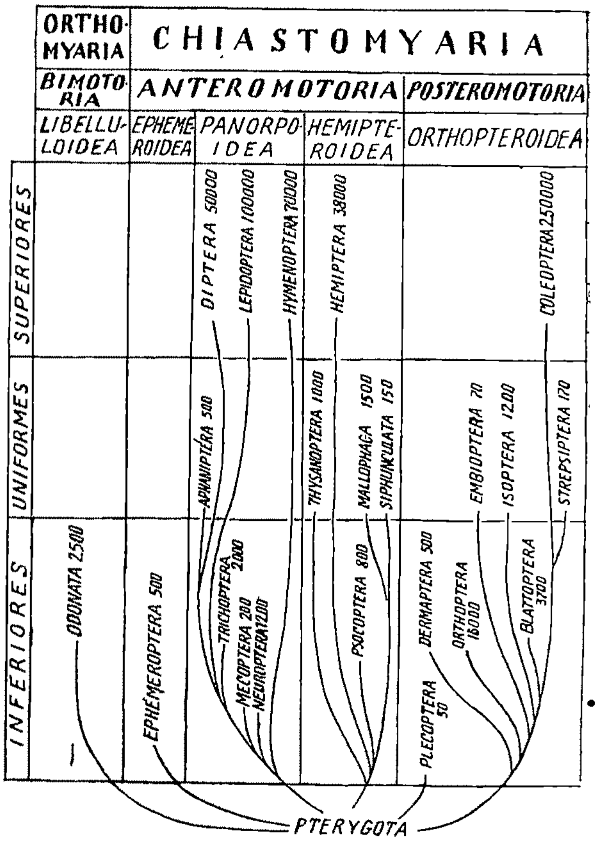
THE acquisition of wings is the most important factor upon which the unparalleled progressive evolution of insects depends. The development of liquid food feeding, though of great moment, plays only a subordinate part as compared with flight. Every order of the Insecta Pterygota shows its own type of wing, and the wing venation serves as a well-established systematic criterion, yet the functional significance of the almost endless variations in venation is as yet scarcely perceived. On the other hand, the musculature of wings shows considerable constancy in the majority of Pterygote orders, its principal modifications being few and functionally comprehensible. Therefore an attempt seems desirable to use 'the muscular motor of the wing' as a taxonomic criterion, especially for the much-needed grouping of insect orders into larger units.

There are two main types of wing motor musculature in insects[1,2]. One of them may be named chiastomyaric. In this, the levators of the wing are dorsiventral and the depressors longitudinal. The directions of the two systems thus cross over one another. Levators are lateral, depressors medial. With the exception of the Odonata, the alary musculature of all the Pterygote orders belongs to this chiastomyaric type. In Odonata the only pair of longitudinal muscles is weak, both the levation and depression being performed by dorsiventral muscles. Contrary to chiastomyaric forms, levators are medial and depressors lateral. Thus almost all the wing muscles of Odonata lie in the same direction and the muscular motor should be termed 'orthomyaric'.

On this basis the whole of the Pterygota can be divided into Orthomyaria and Chiastomyaria (see chart). In the Orthomyaria, that is, Odonata, the two pairs of wings and their motors are alike. Therefore the Orthomyaria represent a Bimotoria group. Among the Chiastomyaria, 'bimotorism' occurs only in the inferior groups like Neuroptera, Mecoptera, Plecoptera and some others, while the higher orders show a strong tendency for one pair of wings to dominate the other, with corresponding distinctions in the meso- and meta-thoracic muscles and skeleton. The process follows two directions. In Anteromotoria the fore-wing becomes dominant, while the hind one may either decrease, be lost (Cloëon), or transformed into a haltere (Diptera), and accordingly the mesothoracic motor is very much stronger than the metathoracic (Hymenoptera, Hemiptera, Lepidoptera. The opposite is the case in the Posteromotoria. Their fore-wings may either turn into elytra (Coleoptera, Dermaptera), or into halteres (Strepsiptera), or show a tendency to elytration (Blattoptera, Orthoptera), or undergo atrophy (many Phasmids), while the hind wings in some groups are either the sole or principal organs of flight. The thoracic skeleton and wing muscles are transformed accordingly, though the domination of metathorax in Posteromotoria is not so pronounced as that of mesothorax in Anteromotoria.

The latter group can be divided into three complexes of orders. One of these is the Panorpoidea, a generally acknowledged group (Neuroptera, Mecoptera, Trichoptera, Lepidoptera, Diptera, Aphaniptera) that shows a strong tendency to proboscis formation and holometabolous metamorphosis. Since the last-mentioned two characters are also present in Hymenoptera, this order should also be included in the Panorpoidea, the erucoid structure of Tenthredinid larvæ being a supplementary proof of the relationship. Another complex is the Hemipteroidea accepted by Martynov[3] under the name of Paraneoptera and comprising the Hemiptera, Thysanoptera, Mallophaga, Siphunculata and Psocoptera. Hemipteroidea differ from Panorpoidea in a still stronger tendency to proboscis formation and an almost complete absence of holometabolous metamorphosis. To the third complex of Anteromotoria, namely, the Ephemeroidea, there belong the single order Ephemeroptera.

As to Posteromotoria, they consist of only one complex, namely, the Orthopteroidea, and contain on one hand the Orthoptera in the old sense of the word (Orthoptera, Blattoptera, Dermaptera), orders regarded[4] as related to them (Isoptera, Embioptera) and the Plecoptera, which show some orthopteroid affinities as well[4]. On the other hand, the Coleoptera with Strepsiptera are also included into the complex. Besides their posteromotorism their inclusion is favoured by the affinities of Coleoptera to some extinct cockroach-like forms[5], the almost total lack of proboscis formation; and their metamorphosis, though complete, is, however, nearer to the hemimetabolous form than to that of the Panorpoids[6].



A SYSTEM OF THE ORDERS OF INSECTA PTERYGOTA BASED MAINLY ON THE STRUCTURE OF WING MUSCULATURE (VERTICAL SUBDIVISION) AND GENERAL LEVEL OF ORGANIZATION (HORIZONTAL SUBDIVISION). CIPHERS AGAINST THE NAMES OF THE ORDERS INDICATE THE NUMBER OF SPECIES IN EACH.

The Orthomyaria consist of a single complex, Libelluloidea, with the single order Odonata.

Thus the whole of the Pterygote orders is subdivided into four complexes, all of which are fairly natural. Except for the positions of the Coleoptera and Hymenoptera, the subdivision corresponds with that proposed under different names by Martynov[3], though his criteria of classification differ widely from those given in the foregoing.

Besides this, the Pterygote orders may be classified under three series shown by the horizontal division of the chart. To the Inferiores belong those orders which show general morphological primitivism, middle- and large-sized body, mostly small numbers of species (excluding Orthoptera) and paucity of biological types (excluding Neuroptera). The Uniformes combine general primitiveness with some narrow specializations (mouth parts of parasites, asymmetrical head and mouth parts of thrips, silk glands of Embioptera). Minute body size, paucity of species and biological types and a strong tendency to apterism are also typical of the series. The Superiores consist of five orders which on account of their maximum morphological specialization, enormous numbers of species and biological types and the widest variability of body size should be regarded as undoubted peaks of insect evolution.

The interrelations of the horizontal and vertical divisions of the chart make it clear that, in each of the three main complexes (Panorpoidea, Hemipteroidea, Orthopteroidea), evolution follows the same course; namely, starting with primitive groups like Mecoptera, Psocoptera or Blattoptera, it leads to the maximum abundance of the forms of life in the progressive orders of Superiores on one hand and to the narrow specialization of the Uniformes on the other. Thus a definite structure is typical of each complex.

The system described is on one hand based on the types of wing mechanism, mouth parts and metamorphosis; on the other, it attempts to take into account the general 'height' of organization, and thus make a distinction between primitive, regressive and progressive orders of Pterygote insects.

---

[1] Weber, H., "Grundriss der Insektenkunde" (1938).

[2] Snodgrass, R. E., "Principles of Insect Morphology" (1935).

[3] Martynov, A. V., "In Filipjev's Opredelitel nasekomykh" (1928).

[4] Martynov, A. V., "Etudes sur l'histoire geologique et de phylogenie des ordres des Insectes (Pterygota) I. Palaeoptera et Neoptera-Polyneoptera". *Travaux Inst. Paleont., Acad. Sci. USSR.*, 7 (1938).

[5] Weber, H., "Lehrbuch der Entomologie" (1933).

[6] Berlese, A. G., "Insetti", 2 (1925).

GEOLOGY IN THE WAR AND AFTER

DR. E. B. BAILEY, in a lecture to the Royal Philosophical Society of Glasgow, delivered on November 17, on "Geology in the War and After", dealt in particular with the work of the Geological Survey of Great Britain, of which he is director. The main war aim has been to give useful advice on: (1) home mineral resources, so as to meet essential needs with economy of shipping and foreign currency; (2) underground water, for new aerodromes, camps and factories; (3) subterranean facilities, for storage and personnel. Coal is the main mineral asset of Great Britain. Two interesting current problems occupy a considerable share of the Geological Survey's time: first, the resurrection, with modern equipment, of coal outcrop working, and second, the correlation of coal seams. Correlation work has been intensified because confused nomenclature impedes progress, that may be expected from the recent unification of ownership in the hands of the State. In its coal work, the Geological Survey co-operates closely with another branch of the Department of Scientific and Industrial Research, namely, the Fuel Research Board, the concern of which is with the quality of the coal seams.

Iron comes second only to coal in importance. Iron ore at present is mostly won from bedded ores in the English Midlands, exploited, as in the case of coal crops, with mechanical diggers. The Survey has done much to help in this wide field. Elsewhere it has directed attention to valuable veins of low-phosphorus iron-ore and has guided their successful development. In regard to non-ferrous metals, the Survey has had successes, but perhaps it is wiser not to particularize. Among non-metallic vein minerals, special attention may be directed to fluor. The Survey warned the steel industry of a possible fluor shortage, and played its part in averting trouble. One important step was to interpret the shape of a particular fluor body, which allowed of ordered replanning of mining operations. In this matter Canadian miners, now sappers, helped greatly by teaching British comrades a novel technique. Felspar may be mentioned here, as a mineral in which, through Survey advice, Great Britain has passed from zero production to self-sufficiency, even in the most exacting grades required for dentures.

Sand and gravel are, of course, always in demand. The year 1939–40 was 'sand-bag year' for London. The coming of war called for rapid reinforcement of existing buildings, and the Survey indicated the particular parks and open spaces where sand-bags could be filled. The Civil Defence authorities have estimated the resultant saving at £125,000. Moreover, external roads and railways were freed for other traffic. Sand of suitable quality for the manufacture of optical glass had been located by the Survey so long ago as 1921, and its significance constantly stressed in the proper quarter during ensuing years. The reward came in 1940, when all Continental sources of this strategic mineral passed into enemy hands. Mica, essential in electrical apparatus, has also been found, of good quality and useful amount.

The importance of the Survey's store of digested information in regard to underground water and underground possibilities of excavation is self-evident. Many inquiries also have been answered upon matters of overseas geology. As a rule, the information has been supplied from the Library; but one member of staff has the privilege of serving as geological adviser in the Central Mediterranean Force, and another was able to visit Malta last spring.

In conclusion, Dr. Bailey expressed the hope that geology would play as useful a part in reconstruction as in war, and that geologists would remember in the future, as in the past, that man does not live by bread alone; in other words, once victory has brought the present emergency to a close, geologists will return to wrestle with the rocks to win from them treasures, intellectual as well as material. It is of happy augury that a geologist, Prof. A. E. Trueman of the University of Glasgow, has been appointed to the small committee that leaves for West Africa in the New Year entrusted with a mission that depends for success upon a combination of good-will, good sense and technical knowledge.

SCIENTIFIC AND INDUSTRIAL RESEARCH IN AUSTRALIA

THE sixteenth annual report of the Department of Scientific and Industrial Research, Commonwealth of Australia, covers the year ended June 30, 942. A large part of the Department's activities is now devoted to the solution of problems arising out of the War, and to assistance and advice to various Government Departments and other institutions and organizations concerned with the war effort, reference o which activities is confined to brief statements or omitted entirely. Among such investigations are those on flax production, vegetable seed production, the possibilities of native and exotic Australian plants or rubber production, the planting and testing of rubber-producing plants from various parts of the world, the storage of foodstuffs and wool and the development of special rations and high vitamin-content extracts for the use of the various Services.

Plant investigations in the field of vegetable fibres have included studies of the microbiology of dew retting and of the actual process of retting to ascertain whether improvement is possible in practice, investigations on pastures and weeds as well as on fruit, although that on general storage disorders has been curtailed. Potato investigations have included a study of virus disease, and a study of the effects of virus *X* on yield has been concluded. Tobacco investigations have been curtailed; but drug-plant investigations have included the extraction of hyoscine and atropine, opium alkaloids, digitalis, ephedrine, ergot, quinine and strychnine, santonin and felix-mas, pyrethrum and native plants as sources of medicinal drugs.

Entomological investigations have covered insect pests in stored wheat and in stored wool, including tests of possible control methods, the insect control of noxious weeds, as well as sheep blow-fly. Other work has been concerned with the development of fly and mosquito sprays, the control of the Australian plague locust, and tests of insecticides designed to control the red-legged earth mite in pasture land. Nutrition investigations at the Animal Health Research Laboratory, Melbourne, have covered pleuro-pneumonia of cattle and mastitis in dairy cattle, while the McMaster Animal Health Laboratory has continued its studies on the administration of phenothiazine, investigations on the efficiency, and economy in the use, of anthelmintics and on external parasites of sheep.

The field staff of the Division of Soils has continued its work, but on a smaller scale, and the Division has also continued spectrochemical work on soils, including a survey of the metallic composition of surface soil at the Waite Institute, problems of anion exchange, with particular reference to the fixation of phosphoric acid, and the determination of small amounts of copper in soil and its availability to plants. No new major lines of investigation have been commenced by the Forest Products Division. Work has continued on the study of fundamental problems on behalf of the Australian pulp and paper industry on the investigation of wood structure in relation to properties, timber seasoning and timber physics, and on wood preservation, as well as on veneering and glueing.

The re-organization of the Division of Food Preservation and Transport has been completed, and all its officers are now engaged on problems of direct importance to the war effort, and chiefly those relating to the canning and drying of foodstuffs. Many investigations on cold storage have been temporarily abandoned. The great expansion in vegetable canning has raised many problems in general canning technology which the Division has been called upon to solve, and the Division undertook a broad investigation into the effect of each step in the canning process on the loss of vitamins in canned vegetables, especially the green-leaf vegetables, cabbage and silver beet. The canning of bacon rashers has been a major investigation. The problem has been to give canned bacon a heat treatment adequate to prevent spoilage and yet not so severe as to destroy the quality of the pack, particularly in relation to texture and form of the rashers. Investigations into substitute materials for the manufacture of foodstuff containers have been carried out. With regard to dried foodstuffs, investigations during the year have been concerned with dried eggs and vegetables. In connexion with experiments on skin coatings for apples, nine different fungicides are being tested for use as control agents to prevent mould waste. Fruit storage investigations on apples have covered the preparation of emulsions of wax, oil, and mixtures of wax and oils, and of their effects on water-loss from fruit and on the resistance of the fruit to the diffusion of oxygen and carbon dioxide. Fundamental work is being conducted on the effect of the thickness of various skin coatings in relation to the size, maturity and the variety of fruit and the temperature of storage.

Fisheries investigations have covered a wide range with a view to the possible development of pelagic fisheries, including investigations on tuna, pilchards and anchovy, and the improvement of methods of mass catching of inshore fish such as salmon for cannery purposes. A survey of the distribution and biological characteristics of edible and other sharks has been inaugurated with the view of stabilizing or, if possible, increasing the supply of oils rich in vitamins from the recently established successful fish-oil industry. Research on agar has been intensified, and studies have been commenced on the preparation of carrageen (Irish moss).

The activities of the National Standards Laboratory have again been largely directed to defence work, including the examination of gauges and measuring equipment, calibration of testing machines, the testing of optical munitions instruments, measurement of the optical properties of melts of optical glass manufactured in Australia, and pyrometry calibration for the Ministry of Munitions. The Aeronautical Division has been increased considerably during the last two years, and is co-operating closely with the Australian Advisory Committee on Aeronautics. The development of methods of construction with synthetic resins is proceeding satisfactorily, and the position in regard to testing equipment for engines has been considerably improved. The Instruments Section has designed and constructed a noisemeter, a recording accelerometer and resistance strain gauges. The Division of Industrial Chemistry has carried out further investigations on the Freney-Lipson process for reducing the shrinkage of wool as well as on the Woolindras process. Attention has also been concentrated on fellmongering, including a physical method of following the depilation of sheepskins, the mechanism of sweating, chemical sterilization of sheepskins and identification of bacteria capable of depilating sheepskins. Attention has also been given to physico-chemical investigations on the flotation of sulphide and non-sulphide ores, and to foundry sands; and an investigation on ethylene as a starting material for the synthesis of commercially valuable organic chemicals has been initiated, including the manufacture of ethylene chlorohydrin. Investigations in the field of synthetic resins have also been commenced, and the building up of a research organization for dealing with friction, lubrication, bearing and wear problems has been continued under which investigations on the theory of metallic friction and the role of shearing and ploughing and on the friction of thin metallic films have been carried out. Other investigations in this field have been concerned with the testing of bearing metals and bearings, the mechanism of lubrication, extreme pressure lubricants, cutting fluids, and the development of lubricants for drawing and pressing, as well as the lubrication and wear of piston rings and cylinders, and the wear and oil-contamination of producer-gas vehicles.

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public)*

Saturday, December 18

Institute of Physics (Electronics Group) (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. L. Jánossy: "Cosmic Rays".

Royal Photographic Society (Scientific and Technical Group) (joint meeting with the Association for Scientific Photography) (at 16 Prince's Gate, South Kensington, London, S.W.7), at 2.30 p.m.—Exhibition of Scientific Photographic Apparatus.

Monday, December 20

Royal Geographical Society (at Kensington Gore, London, S.W.7), at 5 p.m.—Mr. Evert Barger: "Some Problems of Central Asian Exploration" (Tenth Asia Lecture).

North-East Coast Institution of Engineers and Shipbuilders (at the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Mr. W. Muckle: "Some Considerations in the Application of Light Alloys to Ship Construction".

Tuesday, December 21

Union des Ingenieurs et Techniciens de la France Combattante (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 4.30 p.m.—Colonel P. Baranger: "La Reconstruction et l'education technique".*

Royal Anthropological Institute (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—Dr. Otto Friedmann: "Some Czechoslovak Folkways".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Science Teacher at the Flint Day Continuation School—The Director of Education, County Education Offices, Mold, Flintshire (December 24).

Lecturer in Science at the F. L. Calder College of Domestic Science (to be responsible for the teaching of Science applied to Domestic Subjects and of Hygiene)—The Director of Education, Education Offices, 14 Sir Thomas Street, Liverpool 1 (December 27).

Assistant Teacher of Mathematics at the Selby Art School and Technical Institute—The Secretary to the Managers, Education Offices, Garforth, near Leeds (December 31).

Specialist Teacher of Stammering—The Director of Education, Education Offices, Burnley (December 31).

Lecturer in High Voltage Engineering, and an Assistant Lecturer in Mechanical Engineering—The Registrar, College of Technology, Manchester 1 (December 31).

Teacher in Engineering Subjects (possessing Graduate or equivalent qualifications in Mechanical Engineering and Industrial experience) at the Melton Mowbray and District County Technical College—The Director of Education, County Education Office, Grey Friars, Leicester (January 6).

Graduate (temporary) for Mechanical or Civil Engineering Subjects, together with Mathematics, at the Denbighshire Technical College, Wrexham—The Director of Education, Education Offices, Ruthin, Denbighshire (January 8).

Acting full-time Demonstrator of Anatomy—The Dean, Medical College, St. Bartholomew's Hospital, London, E.C.1 (January 11).

Entomologist in the Department of Agriculture, Salisbury, Southern Rhodesia—The Official Secretary, Office of the High Commissioner for Southern Rhodesia, 429 Strand, London, W.C.2 (January 31).

Lecturer on Physics—The School Secretary, St. Mary's Hospital Medical School, London, W.2 (February 1).

Assistant Engineers (Civil) for the Government Railways i West Africa—The Ministry of Labour and National Service, Centr (Technical and Scientific) Register, Advertising Section, Alexandr House, Kingsway, London, W.C.2 (quoting Reference No. E.778A).

Dockyard Manager for the Sudan Railways (candidates should b fully trained Marine Engineers holding University Engineering Degre or A.M.I.Mech.E. or A.M.I.N.A.)—The Ministry of Labour an National Service, Central (Technical and Scientific) Register, Adve tising Section, Alexandra House, Kingsway, London, W.C.2 (quotin Reference No. C.1866a).

Assistant Master or Mistress to teach Geography, and a Assistant Master for Engineering, in the Burton-upon-Tre Technical Institute and Junior Technical School—The Secretary an Director of Education, Education Offices, Guild Street, Burton-upo Trent.

Chief Technical Officer—The Secretary, Warwickshire W Agricultural Executive Committee, 6 Guy's Cliffe Avenue, Leamingt Spa.

Teacher (temporary) of Mathematics to junior engineeri students—The Principal, County Technical College and School Art, Newark, Notts.

Graduate Assistant to teach Physics (industrial and teachin experience desirable), and a Graduate Assistant for subjects u to Higher National Certificate standard in Mechanical Engineerin (candidates must have had practical experience in Engineering a be able to teach Electrical Engineering to the Ordinary Nation Certificate standard), at the West Hartlepool Technical College a Technical Day School for Boys—The Chief Education Officer, Educ tion Offices, Park Road, West Hartlepool.

Speech Therapist in School Clinics for the Remedial Treatme of Stammering and other Speech Defects—The Director of Educati Education Offices, Todmorden, Yorks.

Graduate Assistant Master for Engineering Subjects wi Mathematics in Day Technical School and Evening Institute—Th Principal, Technical Institute, 28 Beckenham Road, Beckenham, Ke

REPORTS and other PUBLICATION

(not included in the monthly Books Supplement)

Great Britain and Ireland

British Rubber Producers' Research Association. Publication N 37: Rubber, Polyisoprenes and Allied Compounds, Part 4: T Relative Tendencies towards Substitutive and Additive Reacti during Chlorination. By G. F. Bloomfield. Pp. 8. Publication N 38: The Course of Autoxidation Reactions in Polyisoprenes and Alli Compounds, Part 3: The Oxidation of Rubber in the Presence Acetic Acid or Acetic Anhydride. By G. F. Bloomfield Pp. 6. (Lo don: British Rubber Producers' Research Association.) [8

Transactions of the Royal Society of Edinburgh. Vol. 61, Part No. 2: The Archaean Rocks of the Rodil District, South Har Outer Hebrides. By Dr. Charles F. Davidson. Pp. 71–112+3 plat (Edinburgh and London: Oliver and Boyd, Ltd.) 6*s*. 3*d*. [8

Board of Education. Educational Pamphlet No. 119: Sex Educ tion in Schools and Youth Organisations. Pp. ii+22. (Londo H.M. Stationery Office.) 6*d*. net. [8

Recruitment and Supply of Teachers: a Short Term Policy for Emergency. Pp. 12. (London: National Union of Teachers.) [8

Other Countries

Smithsonian Institution. War Background Studies, No. 15: I land and Greenland. By Austin H. Clark. (Publication 3735.) P iv+104+21 plates. (Washington, D.C.: Smithsonian Insti tion.) [4

Proceedings of the American Philosophical Society. Vol. 87, No. (August 16, 1943): Symposium on Post-War Problems; Pap read before the American Philosophical Society, Midwinter Meeti February 19–20, 1943. Pp. iii+121–198. (Philadelphia: Americ Philosophical Society.) [4

British Honduras. Abridged Report of the Forest Department the Year ended 31st December 1942. Pp. 8. (Belize: Governme Printer.) [5

Trinidad and Tobago: Forests Department. Administration port of the Conservator of Forests for the Year 1942. Pp. 6. (Tri dad: Government Printer.) 6 cents. [11

Government of India: Department of Labour. Triennial Revi of Irrigation in India, 1936–1939. Pp. 62. (Delhi: Manager of Pu lications.) 2.6 rupees; 4*s*. [11

Bericht über das Geobotanische Forschungsinstitut Rübel Zürich für das jahr 1942. Von E. Rübel und W. Lüdi. Pp. 88- plates. (Zürich: Geobotanische Forschungsinstitut Rübel.) [1

Government of Travancore. Administration Report of the Gove ment Museum for 1117 M.E. Pp. ii+6. (Trivandrum: Governm Press.) [13

U.S. National Museum. Bulletin 100, Vol. 14, Part 2: Contributi to the Biology of the Philippine Archipelago and adjacent Region Descriptions and Figures of New Fishes obtained in Philippine S and adjacent Waters by the United States Bureau of Fisheries Stea *Albatross*. By Henry W. Fowler. Pp. iii+53–92. (Washington, D. Government Printing Office.) 10 cents. [13

Proceedings of the United States National Museum. Vol. 93, 3167: New Species of Buprestid Beetles of the Genus Agrilus fr Trinidad. By W. S. Fisher. Pp. 375–380. Vol. 93, No. 3168: So Fungus Beetles of the Family Endomychidae in the United Sta National Museum, mostly from Latin America and the Philipp Islands. By H. F. Strohecker. Pp. 381–392. (Washington, D. Government Printing Office.) [1

Academy of Natural Sciences of Philadelphia. Monograph No. The Scrophulariaceae of the Western Himalayas. By Francis Pennell. Pp. viii+164+25 plates. (Philadelphia: Academy of N ural Sciences.) [18

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THE IMPERIAL AGRICULTURAL BUREAUX

IT is a pleasant occupation in these times, when so much is being talked about imperial and international co-operation, to study the workings of an organization built up by such co-operation, and the Imperial Agricultural Bureaux furnish a very relevant example. They were set up in their present form by the Governments of the British Commonwealth in 1928 on the recommendation of the Imperial Agricultural Research Conference, and the Governments have been sufficiently satisfied with the organization for them to accept the recommendation of the British Commonwealth Scientific Conference of 1936 to increase their number.

The agricultural bureaux were primarily set up to help research workers in the British Empire to keep abreast of their subjects. All research workers know only too well how many publications may contain information of importance to them, how much they would cost if they had to buy them all, and the great diversity of language used. This difficulty is serious enough for a research worker in a large central research institution, but it becomes insuperable in small isolated institutions. The primary function of the bureaux is to lighten the difficulties of research workers in agricultural institutions by various means: by issuing regular abstract journals and bulletins dealing with recent advances in knowledge in specific subjects; by providing information needed on specific points, with the corollary that the workers themselves must be aware of the existence of the bureaux and have sufficient confidence in them to ask for this information; by arranging meetings between research workers whenever sufficient of them can be brought together; and by acting as advisers or host whenever any of them can make use of that service.

The bureaux have thus a very difficult function to fulfil, as they must contain on their staffs men competent to understand the sciences in which advice is wanted. They cannot, therefore, be a staff of mere abstracters, nor simply secretaries to farm out papers to a panel of abstracters. The men must have experience in agricultural research, so that they can appreciate the peculiar difficulties of any particular subject, but it is equally essential that they should keep abreast of all new ideas. Each bureau was set up alongside a leading research station devoted to that science, to help the bureau staff keep their own knowledge up to date, and to allow any specific problem to be rapidly referred to a leading specialist when necessary.

It was also necessary to ensure that the Empire research workers using the bureaux should have accurate knowledge of what the bureaux can do, and confidence in their competence to do it; and it was accepted that personal acquaintance with the bureau itself was the best way of giving them that knowledge. It was mainly for this consideration that the Governments placed all the bureaux in Great Britain, the country visited by the greatest number of Empire workers.

The bureaux were set up by the Governments of the British Commonwealth, who are jointly responsible for their finance. An Executive Council composed of a nominee from each Government contributing to the fund and of a secretary, who is also in fact the secretary to the Imperial Economic Committee, is responsible for their administration. The Council's work was reviewed by the British Commonwealth Scientific Conference in 1936, and a further review should have been made in 1941, but the War prevented this. In consequence the Executive Council set up a committee, under the chairmanship of Lord Hankey*, to undertake this review, adding in the terms of reference the request for it to report on how the activities of the bureaux can be extended to be of greater service to the British Commonwealth, and making the significant statement "and in general to the United Nations". For these agricultural bureaux have no counterpart elsewhere in the world, and although they were set up for the sole purpose of helping agricultural research workers throughout the Empire, their publications have a considerable circulation throughout the world, and their work is sufficiently highly appreciated for them to be frequently consulted by foreign workers.

At the present time the bureaux fall into two categories: those for entomology and mycology, which were already in existence before the Executive Council was set up, and the ten that have been set up since. These two earlier bureaux, set up under previous Imperial Conferences and financed by the several Governments jointly, have a wider function than the others, for they not only abstract the literature but also identify any pathological insect or fungus found in any part of the British Empire. This makes it necessary for them to have trained systematists on their staffs with adequate laboratory accommodation; to signify this wider function their names were changed from Bureaux to Institutes when they were taken over by the Executive Council. The Entomological Institute is equally concerned with plants and animals, as insects are serious pests on both; but fungal diseases are primarily plant diseases and, in consequence, the Mycological Institute has extended in the direction of plant pathology, and now not only covers the fungal diseases proper but also the virus and bacterial diseases as well. But there are fungal diseases of animals and humans, and here Lord Hankey's Committee found that the Institute was in fact abstracting some papers on medical mycology without any clear indication of what use would be made of these abstracts, as the medical profession was apparently unaware of its existence and, in fact, was barely in need of them since the Bureau of Hygiene and Tropical Diseases issued suitable abstracts on many aspects of medical mycology for the profession. Already a sub-committee has been set up under the Medical Research Council to examine the whole question of abstracting these papers, and the much more serious one of ensuring that medical nomenclature is in line with present-day mycological nomenclature.

Originally eight bureaux were set up directly under the Executive Council to deal with the various groups of agricultural sciences, namely, animal health, animal nutrition, animal genetics, soil science, pasture and forage crops, plant genetics, horticulture and agricultural parasitology (helminthology), to which were added, just before the War, dairy science and forestry. All these bureaux deal with specific branches of agricultural science and, on the whole, meet the needs of the scientific research workers admirably, as they themselves are usually working on one or two of these specific sciences. But there is no bureau for general husbandry, a branch of knowledge barely accepted in Great Britain as a part of agricultural science. The Committee recommends setting up such a bureau, a recommendation which surely should be accepted, as it will involve making an extremely interesting experiment that can profitably be watched by the agricultura research institutes in the country. The main field of general husbandry, excluding economics, is in fact covered by the existing bureaux, but their publications are already so voluminous that it is practically impossible for any one person even to skim through their abstract journals. Nor is it any bureau's business to stress those points of importance for the practical farmer.

The proposed bureau would, therefore, largely duplicate work done by the existing bureaux, and by the Bureau of Soil Science in particular, for on the scheme suggested in the report most of the subject considered suitable for the new bureau fall unde crop husbandry, which the Bureau of Soil Science already covers fairly thoroughly. The value of the new bureau would rather lie in its skill in selecting information lying on the borderline between crop and animal husbandry, but it will have to face the supreme difficulty for a bureau that there is very little literature dealing with these borderline subject owing to their comparative neglect in the development and organization of agricultural research.

One of the greatest benefits a bureau of general husbandry could give to Great Britain is to map out clearly the field of work it can genuinely cover, for once the field has been recognized and defined, th Ministry of Agriculture and the Agricultural Research Council can modify their research policy to allow such a field to be adequately covered. In Great Britain the experimenters in this subject are the progressive farmers, and the descriptions of their methods given in the popular farming journals are usually woefully inadequate for an appreciation of the value and limitations of the work carried out. The bureau might easily have to consider what criteria should be used for judging the value of method tried out on a farm, and this investigation, in itself, would be one well worth undertaking.

There is a further field of imperial agricultural co-operation which could be profitably developed, namely, that concerned with the making of plant collections of value to the plant breeder, and their preservation when made. The United States and the

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* Report on the Imperial Agricultural Bureaux, by a Committee under the Chairmanship of the Rt. Hon. Lord Hankey. Pp. 38. (London: H.M. Stationery Office, 1943.) 1s. net.

U.S.S.R. have each organized many expeditions for the express purpose of making such collections, and just before the War the Executive Council of the Imperial Agricultural Bureaux expanded its scope by financing such an expedition to South and Central America for the collection of wild varieties of potatoes; a collection that may become of outstanding importance, as one of the surprising results of the War has been the way the potato has invaded countries, particularly in the Mediterranean, that barely knew it before, and if this crop is to remain in these countries it will be necessary to raise varieties uited to their conditions.

The development of machinery for ensuring that these collections, once made, are not dispersed is much more difficult, and the Hankey Committee recommends that the Executive Council should interest self in this problem and be able to furnish the next British Commonwealth Scientific Conference with an accurate picture of the collections in existence. The problem might become urgent at any time, as certain institutions throughout the Empire have already made such collections, and if for any reason one of hese institutions had to give up carrying on its collection, or even to reduce it, there is no organiza- ion to save the collection from dispersal or loss. These collections obviously are imperial assets, for hey may contain wild species of little value at the present time but with characters of great importance or other centres or other times. That such collections re international assets as well, so that this is enuinely a problem for international co-operation, no excuse for the Governments of the British Empire not setting up a co-operative organization to feguard such collections wherever they may be.

The creation and preservation of such large living ollections of plant species has thus just begun to be field of imperial co-operation, but, as already ressed, it must also become a field for international -operation, if for no other reason than that it will a very potent instrument for raising the standard living in those countries suffering from chronic alnutrition. Such an organization is, therefore, lmost an essential corollary to the 'freedom from ant' clause in President Roosevelt's famous four eedoms, and to the relevant sections of the Atlantic harter and the Hot Springs Conference.

LIBRARY SERVICE IN GREAT BRITAIN

THE detailed report on "The Public Library System of Great Britain" prepared by Mr. L. R. cColvin for the Library Association, which was blished in September 1942 (see NATURE, March 20, 43, p. 317), has now been considered by a special mmittee of the Library Association appointed by e Council of the Association for that purpose. This mmittee, after considering the report and comments ereon from branches and sections of the Library sociation, public library committees and other erested groups and individuals, has presented its port to the Council; and an official statement of the Association's proposals for the re-organization and development of the public library service of Great Britain has now been issued*. The proposals can thus be fittingly considered against the plan for educational reform now before the nation, with the enhanced demands on the public library service which such reform is likely to stimulate. Equally important, the proposals throw some light on the broad question of local government efficiency and reform, on which opinion is not the less concerned on account of the Government's refusal to consider the matter during the War.

On the latter question, it is unnecessary to remark more than that while the Government may decline to consider local government reform as a whole, we are unlikely, without some definite action, to obtain the improvement in public library services and facilities which is not only desirable but also probably essential if the full advantage of the new educational proposals is to be reaped. Merely to remove the permissive stumbling block in the Acts of Parliament by which public libraries exist will not carry us far when the resources of many local authorities are so small, and an attempt to deal with the regional question alone might well prove an obstacle to subsequent more fundamental reform.

Without recapitulating the conclusions of Mr. McColvin's report, it may be recalled that his survey gave an outstanding impression of generally unsatisfactory provision and of a badly organized service. Even the best administered and supported libraries in Great Britain are still unable to realize the reasonable ideals of their own committees and officers. The wide variations in standards of provision in different areas are depriving many men and women of educational and cultural opportunities which others enjoy. The service is often most defective where it would be most valuable. The permissive principle stands condemned; and many local authorities appear both incompetent as well as inadequately provided with resources so far as library services are concerned.

The Council of the Library Association in its statement follows closely the conclusions of the McColvin report. There are, in its view, four paramount conditions for the development of sound library service throughout Britain. First, the provision of adequate services by suitable library authorities must be made compulsory. Secondly, there must be an appropriate department of the central government responsible for guiding, encouraging and co-ordinating the work of local library authorities and insisting upon their efficiency. Thirdly, all local authorities must be made financially able to attain efficiency; and fourthly, the composition and size of local government areas must be such that the best results are made possible.

In regard to the essential requirements of any system of library service, the statement makes five points. An adequate service must be available to everyone, irrespective of where he may reside, and must include not only reasonable access to appropriate service points, but also the right and the opportunity to draw upon whatever wide resources of books and professional services each individual may require. Every accredited person should be enabled freely to borrow books from, or consult books in, any public library, regardless of his place of residence or employment. The library service should be so organized and provided that it can meet all the legitimate requirements of the community for books and information. Libraries must be controlled by library committees of men and women chosen for their interest in the service and their appreciation of its possibilities, and responsible directly to their local authorities. Finally, libraries must be staffed by capable and experienced chief officers with sufficient suitable and qualified assistants.

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* The Public Library Service: its Post-War Reorganization and Development. Proposals by the Council of the Library Association. Pp. 16. (London: Library Association, 1943.) 6*d*.

The Library Association holds, and we think rightly, that the public library is essentially a local service, and one that should be intimately related with, and responsive to, local needs. Nevertheless, it considers that each library authority's area must embrace a socially cohesive unit, a normal natural congregation of people, and be well related to their ways of living, interests and occupations. In general, the population of a library area should be between one quarter and three quarters of a million, and the area will embrace not only the nucleus large town but also all the surrounding area which is closely related culturally and commercially. This, it is recognized, involves reform of local government areas and functions.

Failing the creation of a new Ministry or Government Department concerned with libraries, museums and other cultural matters, the statement urges that the Board of Education should be made responsible for guiding, co-ordinating and encouraging the development of local library services, but that this responsibility should be exercised through a new and distinct library department of the Board. The officers of this department should be appointed specifically for, and engaged solely upon, library matters. Grants to library authorities from the national exchequer will be necessary to make possible the provision of adequate library services throughout the country, but such grants must be made contingent upon the maintenance of sufficient suitable service points, satisfactory expenditure on books, the employment of sufficient and appropriately qualified staff and payment of agreed national scales of salaries for all grades.

According to the McColvin Report, reference library work is the outstanding failure of librarianship in Great Britain. The Association's statement proposes that a limited number of existing large reference libraries should be specially developed as regional reference libraries. All local authorities should maintain suitable special collections which would form centres for information and bibliography in their respective special spheres for the benefit of the whole country. The National Central Library should be strengthened and developed, and fully supported by adequate grants from national funds, to provide an efficient system for the interchange of the more specialized, older and less readily obtainable material. Both local provision and more comprehensive boo stocks should reduce other inter-library lending to minimum, but the National Central Library shou maintain the appropriate union catalogues, devel and maintain co-operation between libraries of kinds, encourage and co-ordinate the development special libraries, act as a national centre for bibli graphical information, organize international loar and act as a centre and clearing-house for bibli graphical information regarding the literature foreign countries. The cataloguing of books and t provision of necessary bibliographical assistance readers and library staffs should be undertaken on national basis by a central cataloguing departme which could appropriately be part of, or clos associated with, the National Central Library.

Passing over the detailed discussion of the questi of qualified staff, the general argument of wh should be assured of the support of scientific worke we note that an adequate and efficient public libr service is regarded by the Library Association a necessary background to any scheme of adult edu tion. The public library is not to be regarded primar as a part of the formal educational machinery, a its place in the community is well indicated in t section of the statement. Welcome emphasis is l on the importance of relating the public libr service as closely as possible to all other types libraries, such as those of universities, governm departments, scientific and research institutions, e and the national libraries. It may well be hoped t the attention now being given to rehabilitation reconstruction of libraries all over Europe may l to more attention being given to the fundame problems of library co-operation and relations tween special and general collections. The War clearly stimulated closer co-operation, but it sho be remembered that inter-library loans are expen and intrinsically inefficient. Our object should b create the conditions in which such loans are redu to the minimum.

There can be no doubt that the Library Associa is right in its affirmation that post-war Britain need and demand a better library service than yet been fully envisaged by local or national aut ties. It will be remembered that in "Redb University", Bruce Truscot stresses the import of the university library in stimulating though undergraduates. Development and expansion o university libraries to meet the post-war situation scarcely be entirely without reference to the reorg zation and development of the reference lib system, or to the special libraries, if only becau the difficulties and problems in the distribution replacement of stocks, particularly of scientific technical periodicals and the like, to which reference was made at the recent conference hel the Association of Special Libraries and Inform Bureaux. The Library Association thus c ground of the closest interest to scientific wo and their support as citizens should be assure the thorough revision of the law relating to p libraries required to implement the proposals o Association.

THE QUANTITATIVE ASPECT OF PHYSIOLOGICAL REGULATIONS

Physiological Regulations

By Prof. Edward F. Adolph. Pp. xvi+502. (Lancaster, Pa.: Jaques Cattell Press, 1943.) 7.50 dollars.

THE maintenance of relatively constant internal conditions in the face of a fluctuating external environment is perhaps the most characteristic feature of living, as opposed to non-living, systems. Such constancy, however, is only achieved and maintained by active regulatory processes on the part of the animal itself, and an animal only survives in so far as its 'physiological regulations' are competent to oppose and nullify any threatened change in its internal state. All physiological processes, with the exception of reproduction, appear, in the long run, to be devoted to this end; and the physiologist has come to define life as a perfectly integrated series of physiological regulations.

While the existence of physiological regulations has been apparent to everyone, and the physiological machinery by which they operate has, to some extent, been dismembered and examined, there has so far been little or no quantitative study of regulations as such. Prof. E. F. Adolph, in the United States, inspired by the pioneer work of J. S. Haldane and L. J. Henderson, has devoted many years to the measurement of physiological regulations, and his methods, results and ensuing philosophy are now available in this large monograph.

To most physiologists the study of a physiological regulation would imply an inquiry into the machinery —the organs, nerves, hormones and so on—involved. We may say at once that there is nothing of this in Adolph's book. His concern, as he clearly defines, is simply to measure the speed, sensitivity and range of regulatory processes without any consideration of the anatomical and physiological mechanisms by which they are effected. In short, he is interested in what the animal does, but not in how it does it. In general terms, his method is as follows. Any bodily factor which is subject to regulation is called a "component". Components are of diverse kinds; there are chemical constituents, such as water, glucose, oxygen; there are physical constituents, such as heat; there are activities, such as heart-rate. In the case of most components there is a continual turnover during life, and the total content of component is regulated by a balanced adjustment of the rates of gain and loss. The requisite data concerning the regulation of any given component are obtained in the following way. An increase or decrease in the total content of the component is produced by experimental means; this increment is called the "load" and it may be positive or negative. Having established a measured load, the time-course of the recovery process (regulation) is followed by determining the total content at intervals until it returns to normal; if possible the coincident changes in the rates of gain and loss are also followed. These measurements, repeated over as wide a range of loads as the animal will tolerate, provide all the data that are required. From the data a number of correlations can be established between the various variables.

Although some eight or nine different correlations were found to have their individual uses, two of them seem to be of particular value in assessing and characterizing the regulation; they are the equilibration diagram and the velocity quotient. The equilibration diagram is a graph plotting (*a*) rate of gain of component, and (*b*) rate of loss of component, against load. Zero load is placed in the centre of the abscissa and positive and negative loads extend out on either side respectively. At zero load the component is "in balance", rate of gain equals rate of loss, and hence the gain and loss curves always intersect at this point. If gain and loss cannot be separately ascertained, then rate of total change is plotted against load. It turns out that rate of gain and rate of loss are more or less directly proportional to load, though the proportionality is different as between gain and loss and as between positive and negative loads. In other words, the curves of the equilibration diagram tend to be straight lines radiating at different slopes from the point of intersection at zero load. In each case the steeper the slope the more prompt and sensitive is the regulatory process which it represents. The slope of the curve is given by the ratio rate over load; this ratio is the "velocity quotient", and it is a useful unidimensional measure for the efficiencies of the several regulatory processes concerned in the total regulation. The quantities concerned are measured in physiological units, as percentages of the initial total content, so that the equilibration diagrams and velocity quotients in different individuals, in different species, and even of different components, are all directly comparable.

Having thus shown the regulation at work and quantitatively characterized it, Adolph prefers to leave it at that, believing that any inquiry into underlying physiological mechanisms leads to theories of causation which hamper the honest straightforward assessment of the regulation *qua* regulation. In fact he is opposed to any discussion of causation in this connexion, arguing that any consideration of how an animal does things leads to preconceived ideas as to what it ought to do in certain experimental circumstances, and this limits, and may even distort, observation of what it actually does do.

Two thirds of the book is devoted to an exhaustive account of the regulation of the water-content of the body. Water is taken by Adolph as a type component to illustrate his methods in detail; it must therefore be dealt with fully, but, even so, much of the discussion (not the data) in this section could have been condensed; there is much needless repetition and interest flags (to be revived in later chapters).

The methods devised for water are then applied to other components—heat, glucose, lactate, carbon dioxide, oxygen, heart-rate, blood pressure—and are even stretched to cover tissue repair and nervous excitability. Equilibration diagrams are constructed for all these components; the data are mostly taken from the published work of others, the only novelty of the author's method lying in the handling of the data.

The general outcome is that the qualitative pattern of regulation is the same for all components, namely, by appropriate adjustments of the rates of intake or output or both. Indeed, given a turnover, it is difficult to see how it could be otherwise. Adolph makes much of the fact that the general pattern of regulation is always the same, even though the components studied are such diverse entities as water, heat and heart-rate, and even though the physiological mechanisms employed may be totally different in different species. Here one may remark that if, as he insists, the investigation is to be confined to the overall response of the whole animal, with no consideration of the internal mechanisms involved, then it is scarcely surprising that only a broad and all-embracing pattern can be discovered. There are, of course, marked quantitative differences in the regulations of different components, and of the same component in different species. There are many interesting details to be found here, too numerous to mention; a large number of previously recorded but scattered and forgotten facts are brought together in a new context.

Thus it is interesting to note that, on the basis of quantitative difference, 121 different patterns of equilibration diagram are theoretically possible, but only twenty-five of these are compatible with recovery (regulation), and, of these, only six have been found in operation among the various components and species so far studied. So there are nineteen which may yet turn up. With regard to species differences, it is found that if in any one species the equilibration diagrams for the different components are collected together, they form a pattern which serves to characterize the species. Such physiological characterization of species is no less real than the usual morphological characterization; indeed, it may prove more sensitive in certain instances, and it opens up a new line of thought in comparative physiology.

The most interesting chapter in the book is that on the "Interrelation of Components". Here we study the effect of varying (loading) two or more components at once, and also the effect which loading of one component has on the regulations of other components. Now, the equilibration diagrams of several different components are plotted together on a common set of physiological co-ordinates and we see something quite new—we see the beginnings of a map which would show the integration of the whole animal. This simultaneous handling of different components on one map is perhaps the most important outcome of Prof. Adolph's methods; one has a feeling, for the first time, of getting to grips in a quantitative way with that elusive kernel of physiology—integration. We all know it exists, but now we can begin to measure it, and "science is measurement". Owing to the limited data available only a small field has so far been mapped; but the general picture of integration which emerges is that of a network of interrelated components forming a stress-strain system which is complete in itself. Integration is not some master control superimposed on the observed phenomena; it is just the total map of all the correlations observed. The individual regulations are remarkable enough in themselves, but it is their mutual compatibility which is amazing, and, one may say, the riddle of life.

As already mentioned, in the study of regulations, Prof. Adolph is opposed to any discussion of causation on the ground that it limits inquiry. Many will cross swords with him here, and some may take exception to his somewhat deprecatory references to the "cause-seekers", who must include most present-day physiologists. Cause-seeking he looks upon as the "original sin" of physiologists; it leads to the "accumulation of a body of qualitative facts about which are built up projected or extrapolated aphorisms". He believes that existing data can yield new and significant correlations when handled by his methods, such correlations having hitherto been overlooked simply because observers have, on the whole, only looked for the particular correlations which were suggested by the existing theories. He believes that further knowledge of regulations and integration can best be sought by collecting all the possible data concerning the body and making al the possible correlations, in advance of theoretica speculation.

This point of view, though alien to the classica traditions of physiology, is quite justifiable. There is nothing against it; the only criterion will be —Does it yield worth-while results? It is too soon to say. With regard to the regulation of individua components, nothing very new has emerged; known phenomena have simply been made quantitative but with regard to the interrelation of components and the integration of the whole animal, there does seem to be in his methods the germ of a new and fruitful line of attack. Integration, that most obscure and yet most fundamental aspect of physiology certainly calls for new methods and a new attack; present methods have yielded little and they are for the most part exhausted. A great deal of the quantitative data amassed by physiologists for diverse reasons can be re-examined in the light of regulations and analysed by Prof. Adolph's methods. Many workers will find it possible to apply this analysis to the data of their own researches, and it may lead to a new and probably broader view of their problems.

The book does not make easy reading. It is a difficult subject, of course, but often it seems that an unnecessary obscurity has crept in through too much reliance on abstract terms. The 186 graphic figures are excellent and are a sheet anchor to the persevering reader. The author sums up his work quite fairly as "an attempt to formulate and represent quantitatively many notions relative to regulations that are vaguely and partially present in the minds of all physiologists". O. A. TROWELL.

HISTORY OF CATTLE BREEDING

American Dairy Cattle

Their Past and Future. By E. Parmalee Prentice; with Chapters on Dairy Cattle in America, by Ernest L. Anthony, Lloyd Burlingham, Clifford L. Clevenger, Clifford T. Conklin, Lynn Copeland, Herbert P. Davis, Rockefeller Prentice and Edwin G. Woodward. Pp. xix+453+51 plates. (New York and London: Harper and Brothers, 1942.) 3 dollars.

CLAIMS have been made that certain American breeds of dairy cattle are of immemorial antiquity in their modern form. These claims are set out in herd books, the earliest of which were published in America, and even in publications having the *cachet* of the U.S. Department of Agriculture. History cannot substantiate these claims, and Mr. Parmalee Prentice has successfully demolished them by his careful examination of the evidence and this record of his conclusions.

Since all the cattle in America are descendants of European immigrants, he has been forced to cover a wide field, and, in this connexion, it will be recalled that British breeds of cattle as we know them are of quite recent origin. The first great British breeder was Bakewell (1725–95) and he worked with long-horn cattle, a breed now almost extinct in Britain. What his system was is not known, but it was undoubtedly based upon mating the best with the best in the terms of that day's judgment, and rigorous culling of the offspring that failed to reach the required standard.

From Bakewell's day onwards cattle breeding was in favour among great and wealthy landowners as well as rich tenants of large farms, because the old open-field system had been superseded by enclosed farms, and control of mating was possible. Formerly, as Lord Ernle succinctly puts it, for at least ten centuries "stock breeding, as applied to both cattle and sheep, was the haphazard union of nobody's son with everybody's daughter", and even in the great age of breeding, say 1770–1870, an infinity of crosses was tried. Almost every so-called breed was crossed with almost every other: Devon with Hereford, Hereford with Shorthorn, Shorthorn with anything and everything, Devon with Sussex and so *ad infinitum*. Few, if any, of the British breeds can claim that its contemporary external characters are more than a hundred and fifty years old; most are much less than a century, and the British dairy-breed herd books are more recent still: Jersey 1883, Ayrshire 1878, Guernsey 1885, British Friesian 1912.

It is on the foundation of such facts as these that Mr. Prentice bases his onslaught on the conception of 'pure bred' breeds of cattle. The old principle that 'like begets like' is a fallacy, for brothers and sisters vary widely, and this is no safe rule to breed by. Again, he holds that the mating of high-producing cows to sons of high-producing cows is likely to lead to failure. In place of this system he suggests the use of the Mount Hope index. This implies that the milk and butter-fat must be recorded every year for every daughter and every mate of a given bull, and that the inheritance the bull transmits is found by comparing the average production of all the bull's mates with the average production of all his daughters.

Mr. Prentice's history is stimulating. His criticism of breeding methods is equally so, and his demand that the Mount Hope index, which is based upon performance and not upon type and pedigree, should be used is certainly one that deserves careful consideration; although as Prof. H. G. Robinson has pertinently remarked, "If the bull is regarded as being at least half the herd, the cow shapes the destiny of her own progeny. . . . A good bull deserves good cows."

G. E. FUSSELL.

THE CLIFTON PARK SYSTEM

The Clifton Park System of Farming and Laying Down Land to Grass

A Guide to Landlords, Tenants and Land Legislators. By Robert H. Elliot. Fifth edition. Pp. 261+8 plates. (London: Faber and Faber, Ltd., 1943.) 12*s*. 6*d*. net.

THIS is a new edition of a book long out of print but well known to agriculturists in the early years of the present century. It was no ordinary volume on grassland management, much less a text-book. It was a book with a purpose, namely, to bring to the notice of farmers, landlords, and if possible the administrators, the merits of a certain system of farming as a means of meeting the prevailing agricultural conditions. The interest of the book to present-day readers lies not so much in the detailed methods adopted by Elliot in the field, but rather in light shed on the agricultural problems of the closing years of the nineteenth century and the picture it gives of a man of highly independent mind striving to influence his fellow farmers with rather less than no support from official sources. Indeed the Board of Agriculture and the newly formed agricultural colleges were supporting the "fertilizer and feeding stuff" approach to farming, which in Elliot's view would be largely unnecessary under a rational system of grassland management.

R. H. Elliot, after a period spent as a coffee planter in India, returned to his property at Clifton Park in Roxburghshire and devoted more than thirty years to developing and demonstrating on his farm an alternate husbandry of four-year leys followed by four arable crops for livestock. In this he saw a method of reducing costs, maintaining and improving soil fertility, and increasing the output of the land. This rotation differed from those usually employed at the time in several respects: the grass was left down longer before being ploughed up, the quality of the grass and clover seeds was very much better than was commonly attained at that time, certain species of plants chosen for their deep rooting and drought-resisting habits were included in the seed mixtures.

As a planter and later as a landlord, Elliot was much impressed by the results of soil exhaustion, which he rightly viewed as a matter of the greatest national consequence. He had no faith in artificials as a remedy, and argued eloquently in favour of organic matter coupled with nitrogen derived from legumes as the basis of soil fertility. These could be obtained most cheaply from good grass well stocked, and each time the land was so treated the results improved. As fertility rose the dependence on artificials and concentrated stock foods steadily diminished, as the results of his farming operations showed.

In the course of his work Elliot raised many points of grassland husbandry that called for research for their final solution. This research was not at the time forthcoming. Many of his ideas have stood the test of time; late-flowering red clover, for example, regarded by him as the mainstay of his leys, still maintains its reputation. In his condemnation of rye-grass he was perhaps too sweeping, as improved strains of this grass have abundantly justified themselves on the more fertile soils. His deep-rooting plants on which he counted so much for opening up poor thin soils are not widely included in present-day mixtures, although their good points for certain conditions are admitted. Other pasture plants, notably wild white clover, scarcely mentioned by Elliot, who sowed the ordinary Dutch clover, have had a most profound influence in the productivity of grassland.

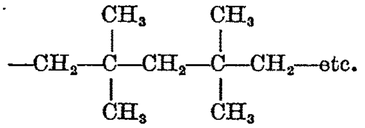
Many of Elliot's proposals which had little support in his time came to pass later. The trade in agricultural seeds has been greatly improved by the Seeds Act 1920 and the resulting activities of the Seed Testing Station at Cambridge. Experimental work on herbage plants and grassland problems has developed in a variety and to an extent that he could not possibly have foreseen, though undoubtedly he would greatly have welcomed them. Agricultural education has left its mark on the farming community, and Elliot's dictum that, "It is well known that, with but few exceptions, agriculturists will not read, and are indeed averse to any form of intellectual exertion" is much less true now than it may have been.

The book gains greatly for modern readers by an excellent preface by Sir George Stapledon, who gives it the necessary orientation in relation to subsequent grassland developments.

STERIC HINDRANCE AND HEATS OF FORMATION

By Dr. A. G. EVANS and Prof. M. POLANYI
University of Manchester

IN the low-temperature polymerization of isobutene by boron fluoride, BF_3, the heat of polymerization, which has been found to be in the neighbourhood of 10 kcal. per mole, is lower than would be expected on the basis of theoretical calculations[1]. Both chemical[1] and X-ray[2] evidence support the head-to-tail chain-structure :

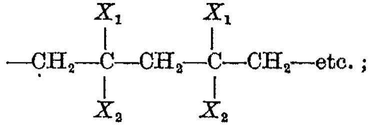


$$-CH_2-\underset{CH_3}{\overset{CH_3}{C}}-CH_2-\underset{CH_3}{\overset{CH_3}{C}}-CH_2-\text{etc.}$$

for poly*iso*butene, but, as has been recently pointed out by Rossini in a private communication to Flory[3], an attempt to build a model of this molecule indicates that there is great steric interference between the methyl groups of successive *iso*butene units. Flory suggests that this steric interference is the reason for the low heat of polymerization of *iso*butene. We have, ourselves, been working for some time on lines suggested by similar considerations of steric hindrance, and, in order to investigate the relation between such hindrance and heats of formation, we have measured the heats of polymerization of *iso*butene, and of the structurally related substances di-*iso*-butene, methyl methacrylate and acrylic acid.

Polymerization of the 1.1 di-substituted ethylene, $CX_1\,X_2 = CH_2$ can lead to a head-to-tail structure :

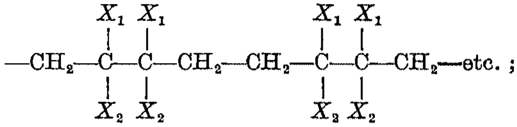
(*a*)



$$-CH_2-\underset{X_2}{\overset{X_1}{C}}-CH_2-\underset{X_2}{\overset{X_1}{C}}-CH_2-\text{etc.};$$

or to a head-to-head, tail-to-tail structure :

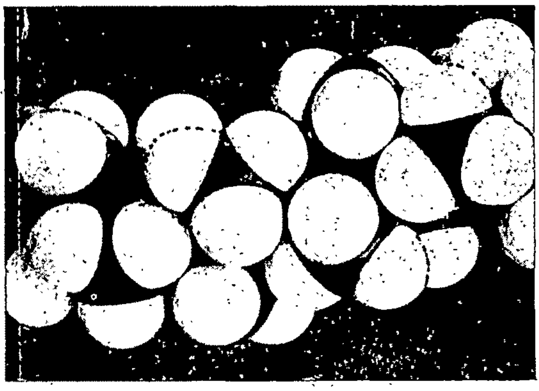
(*b*)



$$-CH_2-\underset{X_2}{\overset{X_1}{C}}-\underset{X_2}{\overset{X_1}{C}}-CH_2-CH_2-\underset{X_2}{\overset{X_1}{C}}-\underset{X_2}{\overset{X_1}{C}}-CH_2-\text{etc.};$$

or to a mixed structure containing both these types. Models of these two structures were built for poly*iso*butene ; that is, when X_1 and X_2 are CH_3 groups.

In the poly*iso*butene molecule of head-to-tail structure (*a*), it was found that the steric interference between the methyl groups was so great that in order to build a model of the molecule, successive *iso*butene units had to be rotated with respect to each other so that the methyl group of one *iso*butene unit fitted in between the two methyl groups of the next *iso*butene unit, as seen in the accompanying photograph of a model. In this way the molecule assumed a spiral configuration, and was found to be quite rigid owing to the close interlocking of the methyl groups. In the Fisher-Stuart models used, the covalent radii of the hydrogen and carbon atoms and the van der Waals radius of the hydrogen atom had their usually assumed values[4]. The van der Waals radius of the carbon atom was 1·35 A. The observed van der Waals radius of carbon is about 1·85 A. in aromatic molecules and 1·7 A. in graphite[4]. Using the rule derived by Pauling[4] that the van der Waals radius is equal to the covalent radius plus 0·8 A. gives a value of 1·57 A. All these values are greater than the van der Waals radius of the model carbon atom used. The extent of the steric hindrance involved in building up the molecule can be realized by the fact that it was only just possible to fit the model together although the van der Waals radius of the carbon atoms was about 0·35 A. less than normal.



Model of poly*iso*butene molecule.

When the poly*iso*butene molecule was built according to the head-to-head, tail-to-tail structure (*b*), it was found that no steric hindrance occurred. Furthermore, when the monomer was a monosubstituted ethylene (that is, X_2 was H) both types of polymer molecule were found to be free from steric hindrance.

Thus, for any 1.1 disubstituted ethylene, we should expect the heat of formation of the head-to-tail polymer of type (*a*) to be less than the normal value owing to steric hindrance. For monosubstituted ethylenes, on the other hand, the heat of formation of both types of polymer should be normal ; and the same should be true in general for 1.2 disubstituted ethylenes.

The heat of formation of a polymer such as polythene or poly*iso*butene can be calculated from rules derived from data of Rossini and Kistiakowsky on the heats of formation and hydrogenation of the lower hydrocarbons. The heats of polymerization of various monomers have been calculated in this way by Flory[5]. These heats of polymerization calculated from data on the lower hydrocarbons, where no steric hindrance exists, refer to polymer molecules which are *ex hypothesi* sterically unstrained. In this way, using the more recent heats of formation obtained by Rossini[6], we have re-calculated the heat of polymerization of gaseous *iso*butene to a sterically unstrained gaseous poly*iso*butene as 21·4 kcal. per mole. If we assume that the latent heat of vaporization per gm. and the heat of solution per gm. are the same for the polymer as for the monomer, then the heat of polymerization of liquid *iso*butene to liquid poly*iso*butene, and the heat of polymerization of *iso*butene in solution, will also be 21·4 kcal. per mole in the absence of steric hindrance.

The heat of formation of liquid poly*iso*butene from the elements has been determined experimentally[7]. From this value and the heat of formation of liquid *iso*butene (as calculated from the heat of formation of *iso*butane[8] and the heat of hydrogenation of *iso*butene[9], and the latent heat of vaporization of *iso*butene), we have calculated the heat of polymerization of liquid *iso*butene to liquid poly*iso*butene as 11·5 kcal. per mole. We have measured the heat of polymerization of *iso*butene in solution. The results gave an average value of 12·8 kcal. per mole. In view of the inaccuracy of the heats of combustion involved in Richardson and Parks' value, the agreement between these two values is sufficient, and justifies our assumption that the heats of solution per gm. of *iso*butene and poly*iso*butene are the same. Both these experimental values for the heat of polymerization of *iso*butene are some 9 kcal. per mole less than the value of 21·4 kcal. which would be expected in the absence of steric hindrance in the polymer.

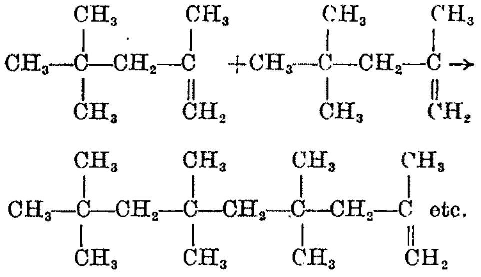
We have calculated the heat of polymerization of gaseous isoprene to a sterically unstrained polymer molecule as 18·7 kcal. per mole. The experimental value for the heat of polymerization has been determined as 17·9 kcal. per mole[10]. The agreement between these two values confirms the expected absence of steric hindrance in the polymer molecule.

For the monomer $CH_3\text{—}CX_1 = CH_2$ we expect the steric hindrance of the polymer of structure (*a*) to be greatly increased when X_1 is changed from CH_3 to C_2H_5. When X_1 is *s*-propyl, *t*-butyl, or neopentyl we expect the large steric hindrance involved to make polymerization impossible. We see a confirmation of this last point in our observation, discussed below, that di-*iso*butene, in which X_1 is neopentyl, forms only a dimer under conditions which lead to polymerization of *iso*butene (the action of boron fluoride at room temperature or lower temperatures).

When X_1 is $COOCH_3$, or C_6H_5 (that is, when the monomer is methyl methacrylate or α-methyl styrene), we expect the steric hindrance of the polymer of structure (*a*) to be of the same order as for poly*iso*butene, where X_1 is CH_3. The fact that the steric hindrance caused by the large groups $COOCH_3$ and C_6H_5 is of the same order as that of CH_3, is because the carbon atoms which join them to the polymer backbone have coplanar and not tetrahedral valencies. This enables the adjacent groups to lie in planes parallel to each other, so that although they are large their mutual interference is of the same order as for CH_3. We have measured the heats of polymerization of methyl methacrylate and acrylic acid and find values of 11·6 kcal. per mole and 18·3 kcal. per mole respectively*. It seems reasonable to attribute the difference to the presence of steric hindrance in the case of the 1.1 disubstituted ethylene, and its absence in the monosubstituted ethylene. This involves the assumption that the polymer of methyl methacrylate is at least predominantly of the head-to-tail type. The theoretical values for the sterically unstrained polymer cannot be calculated in this case.

The smallest molecule in which we would expect steric hindrance to be marked is the nonane $C(CH_3)_3 . CH_2 . C(CH_3)_3$. This molecule has the same structure as a section of the head-to-tail poly*iso*butene molecule. In the nonane $C(CH_3)_3 . C(CH_3)_2 . CH_2 . CH_3$, which is of a head-to-head type, little steric hindrance should be observed. Experimentally, we found signs of steric hindrance reducing the heats of formation in the dimerization of C_8H_{16} to $C_{16}H_{32}$ by boron fluoride. For the heat of this dimerization we find the upper limit of 14 kcal., whereas the value calculated in the absence of steric hindrance would be 20 kcal.

The dimer $C_{16}H_{32}$ was identified as an olefine. This excludes its formation through the intermediate stage of free radicals, since in this case the only possible dimer would be a saturated compound containing a four-membered ring. The mechanism of dimerization, therefore, must consist in the migration of a hydrogen atom from one monomer molecule to the other. If any methyl group would serve equally well for the production of the migrating hydrogen atom, one would expect that the action of boron fluoride on di-*iso*butene would produce some poly*iso*butene thus :

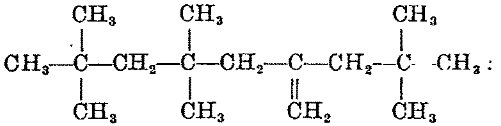


$$CH_3\text{—}\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{—}CH_2\text{—}\underset{\underset{CH_2}{\|}}{\overset{\overset{CH_3}{|}}{C}} + CH_3\text{—}\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{—}CH_2\text{—}\underset{\underset{CH_2}{\|}}{\overset{\overset{CH_3}{|}}{C}} \rightarrow$$

$$CH_3\text{—}\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{—}CH_2\text{—}\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{—}CH_2\text{—}\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{—}CH_2\text{—}\underset{\underset{CH_2}{\|}}{\overset{\overset{CH_3}{|}}{C}} \text{ etc.}$$

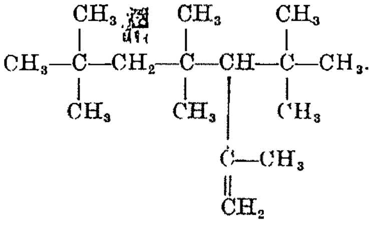
The fact that this does not occur indicates that the terminal methyl groups farthest from the double bond are not active as regards the liberation of hydrogen atoms. The absence of reactivity in these groups is in accordance with the observed behaviour of the methyl groups of a saturated hydrocarbon, as shown by the fact that when a solution of *iso*butene in hexane is treated with boron trifluoride there is no reaction between the *iso*butene and the hexane. It follows that the only active groups in the di-*iso*butene molecule are the methyl and methylene groups attached directly to the double-bond carbon. These groups are active by virtue of the resonance which can occur in the radical $R\text{—}\underset{\underset{CH_2}{\|}}{C}\text{—}\dot{C}H_2$ or the ion $R\text{—}\underset{\underset{CH_2}{\|}}{C}\text{—}\bar{C}H_2$ which is formed by the loss of a hydrogen atom or a proton.

If the migrating hydrogen atom is supplied by the methyl group, then the dimer molecule will have the structure :



$$CH_3\text{—}\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{—}CH_2\text{—}\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{—}CH_2\text{—}\underset{\underset{CH_2}{\|}}{C}\text{—}CH_2\text{—}\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{—}CH_3 ;$$

and if it is supplied by the methylene group the structure of the dimer will be :



$$CH_3\text{—}\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{—}CH_2\text{—}\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{—}\underset{\underset{\underset{\underset{CH_2}{\|}}{C\text{—}CH_3}}{|}}{CH}\text{—}\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{—}CH_3.$$

Both these compounds are olefines, which show the presence of strong steric hindrance. Further growth by this mechanism would be increasingly difficult sterically and would be accompanied by still further reduced, probably prohibitively small, heats of formation. These are the characteristic features observed in the action of boron fluoride on di-*iso*butene.

If we consider that the polymerization of *iso*butene occurs by the same mechanism as that which we have deduced for di-*iso*butene, we find that the structure of poly*iso*butene must be of the head-to-tail type, in accordance with the evidence quoted earlier on.

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* We note that Goldfinger, Josefowitz and Mark (*J. Amer. Chem. Soc.*, 65, 1432; 1943) found the value 7·9 kcal. per mole for the heat of polymerization of methyl methacrylate. While we are not in a position to argue the point until the detailed publications can be examined, we believe our value to be correct. In any event, the difference would not affect the argument of this article.

The above considerations would still apply on the assumption that the migrating hydrogen atom came from the $=CH_2$ group, but the eventuality does not seem worth discussion, since such hydrogen atoms are known to be unreactive. as exemplified for the present case by the absence of reaction when ethylene is acted on by boron fluoride.

Our thanks are due to Imperial Chemical Industries, Ltd. (Billingham), for directing our attention to the problem and supplying us with information and material. We also wish to thank Prof. M. G. Evans for important advice on the method of polymerizing methyl methacrylate and acrylic acid, and Mr. J. H. Allen for experimental help.

A detailed account of these experiments will be published after the War.

[1] Thomas, Sparks, Frolich, Otto, Mueller-Cunradi, *J. Amer. Chem. Soc.*, **62**, 276 (1940).

[2] Fuller, Frosch and Pape, *J. Amer. Chem. Soc.*, **62**, 1905 (1940).

[3] Flory, *J. Amer. Chem. Soc.*, **65**, 372 (1943).

[4] Pauling, "The Nature of the Chemical Bond" (Cornell University Press, 1940).

[5] Flory, *J. Amer. Chem. Soc.*, **59**, 241 (1937).

[6] Rossini and Knowlton, *J. Research. Nat. Bur. Standards*, **19**, 339 (1937). Prosen and Rossini, *ibid.*, **27**, 289, 519 (1941).

[7] Richardson and Parks, *J. Amer. Chem. Soc.*, **61**, 3545 (1939).

[8] Rossini, *J. Research. Nat. Bur. Standards*, **15**, 361 (1935).

[9] Kistiakowsky, Ruhoff, Smith and Vaughan, *J. Amer. Chem. Soc.*, **57**, 881 (1935).

[10] Jessup, *J. Research Nat. Bur. Standards*, **20**, 589 (1938).

THE REGIONAL CONCEPT IN GEOGRAPHY

By W. FITZGERALD

University of Manchester

BEFORE the autonomous development of the natural sciences occurred, geography embraced almost all investigations of terrestrial phenomena. This was largely true until the Renaissance and the important voyages of discovery greatly enlarged man's knowledge of the earth's surface. As the sciences took shape in turn it became necessary for geography, in order to retain its identity, to develop its own method, discipline and philosophy and to define the limits of less comprehensive but more specialized investigations. It became, moreover, equally important to state or re-state the relationship of geography to those sciences with which its contacts are closest.

Geographers were slow to adjust their philosophical frontiers to the expansion of science. In the late nineteenth century they had particular difficulty in defining the position of their subject in relation to geology and ethnology, which were reaching full maturity. More recently, meteorology has claimed independent status, and its relation to geography still awaits satisfactory adjustment. The sciences named are those with which geography retains the closest contacts, and between them and geography the boundaries are not always easy to determine.

During the last half-century geographical studies in Britain have undergone a transformation similar to that which occurred in France and Germany at an earlier time. The philosophical evolution of geography has not, however, greatly affected those who would limit the subject to the physical phenomena of the earth's surface and exclude man's adjustment to environment from their terms of reference. The study of land-forms (geomorphology), the atmosphere and the oceans, which comprised the physiography of the late nineteenth century, is the interest of those who claim that scientific geography can go no farthe But much of the geomorphology which passes fo physical geography is concerned with the evolutio of land-forms. As such it is geology. This was mad clear so long ago as 1887 by Prof. J. Geikie when h wrote, "The moment the physical geographer begin to inquire into the origin of any particular physic feature he enters upon the domains of the geologist" The great geomorphologists—Lord Avebury, Arch bald Geikie, Grenville Cole, and others of a recen generation—were geologists primarily, though the secondary interests enabled them to make distin guished contributions to physical geography.

The physical geographer is not required to approac the study of land-forms from the same point of vie as the geologist. He is principally concerned wit the actual geographical location of terrestrial ph nomena and with their spatial relationships withi the regional framework of the world; so that hi statements must be capable of being expressed cartographically. In physical geography, as in all aspect of geography, if the problem cannot be studied b means of maps, particularly by a comparison maps of related distributions, it is questionable the work is legitimate. It is more usual than not fo geomorphologists to exclude man from those agencie which determine landscape. Yet to the geographe the changes wrought by man's occupation of the eart are undeniably important. The deforestation of continental areas, the drainage of marshes and shallo seas, the canalization of rivers, the tunnelling mountain-systems are all features of the physic environment which are as 'natural' as those wrough by geological or climatic agencies—that is, if w accept man as a part of Nature.

A line of argument similar to that used in definin the relations of geology and geography may be followed in tracing the relation of physical geograph on its climatic side, to meteorology. The physic of the atmosphere is not a branch of geography, an a meteorologist undertakes his researches withou necessarily possessing a geographical outlook. Th climatic geographer is particularly interested in th zonal or regional arrangement and distribution climates; whereas the geographer (without prefix), i addition to this, undertakes the investigation of th relation of climate—as one aspect of physical environment—to the life of mankind, the setting of th inquiry being, as always in geography, an areal uni or region.

To the geographer the pattern in which phenomen are arranged within an area is a matter of primar importance. He is concerned not only with thei spatial relationships, but also with their interaction as, for example, the effect of climate on the characteristics of vegetation. The geographical patter changes, usually by a graded transition rather tha abruptly, from one area to another, and grants distinctive character—a 'personality'—to the unit area called the 'region'. As the region is a concept its frontiers are fixed not by Nature but by th geographer, and there may not always be agreemen among geographers regarding either the regiona boundaries or the criteria on which the delimitatio of the region is based. Regions provide a framewor which is convenient and, indeed, necessary for th systematic investigation of the environment of man Without such a regional plan of the world as an instrument, systematic geographical investigation is no possible. There is, unfortunately, the necessity t employ the term 'region' for every unit of are irrespective of its magnitude, as the English language is deficient in words which signify regions of different dimensions. Attempts to coin regional terms, comparable to 'pays' of the French, have, unfortunately, failed to obtain general recognition from the main body of geographers.

The division of the world into political units is scientifically unsatisfactory to the geographer, because the criteria on which it is based bear no necessary relation to geographical reality; and largely because of the inadequacy of States as geographical units the idea of the 'natural region' has been introduced. Its theory is to group together geographically the factors of environment within a scientifically acceptable framework in order the better to investigate their spatial relationships. A comparison of the historian's and the geographer's methods may help to clarify the purpose of regional division. The historian, confronted with the investigation of all history, prepares a chronological system of periods, according to criteria the relative importance of which he alone is able to determine. Only by such a division of time is he enabled to undertake the detailed investigations which are essential to the standards of historical scholarship.

The theory of natural regions was introduced to geographical thought in Great Britain by Herbertson of Oxford at the beginning of this century. The validity of the system which he devised is still widely acknowledged, though there have been alternative systems, notably those of Continental geographers. To Herbertson climate was the factor of environment which exerted the greatest influence on man; and for him it was the principal criterion of regional division. There is a considerable measure of agreement regarding the indirect influence of climate on civilization through the medium of its control of earth-sculpture, soil characteristics and vegetation, though there is objection to a theory of the climatic control of human life. Other, but subsidiary, criteria introduced by Herbertson to his regional division of the world included both orography and situation with reference to land and sea, but in the last analysis his regions are of climate. As such they comprise merely one category of natural region with which may be compared regions of vegetation and geomorphological regions, which are equally 'natural'.

All such systems agree in their limitation of the term 'natural' to phenomena which are external to man and unaffected by his activities. In recent time, however, certain geographers have claimed for man, as the architect of the cultural landscape, a place in a system of natural regions. To them the cultivated soil, for example, is a phenomenon as 'natural' as the primeval forest. The introduction of man as an agent of geography greatly complicates the attempt to reach an agreed basis of regional division. Nevertheless, it demands attention, more particularly because of its service in bringing together in fruitful relationship the physical geographer and the geographer of humanistic interests.

The wide divergence of interests between geographers in Great Britain would probably not have arisen if the subject had been consolidated at the time when geology and ethnology were completing their separation from it. For such a task a man of scientific and philosophical equipment equal to Alexander von Humboldt or Carl Ritter was required; and it is regrettable that there was no such British geographer in the nineteenth century to prepare the foundations. The backwardness of geographical investigations in Britain during that century, in contrast to the great activity in France and Germany, demands an explanation, but for our present purpose it is sufficient to indicate that geography in Britain suffered from both lack of discipline and uncertainty of objective in the early stages of its active growth.

When physical geography is re-orientated, with the regional concept at its centre, as already proposed, a considerable advance will have been made towards the elimination of the dualism which now permits the physical geographer and the geographer of humanistic interests to follow divergent courses. The unification of the subject would be assisted by the abandonment of the term 'human geography' which has only recently come into currency. It is widely misunderstood, as well it might be, for it is a mistranslation of 'la géographie humaine' which cannot be so literally rendered in English.[1] The aspects of geography which it comprises are social, economic and political, and as prefixes to 'geography' these adjectives are sufficient. (The legitimacy of 'racial geography' is more doubtful, and will be mentioned later.)

The unification of geography depends, however, on more than the elimination of an unsatisfactory yet widely used term. It proceeds from the recognition by the geographer of humanistic interests—whether social, economic or political—that, like the physical geographer, he is concerned with the spatial relationships of certain phenomena which are involved in the life of man within a region, or series of regions. He investigates the geographical record of man's activities in economic, social and political affairs, but his unit of study, it cannot be too strongly insisted, is the place or region.

The place of man in geography offers the greatest of all practical difficulties in the systematization of the unified subject. Man is studied from different points of view in a number of other sciences, including physical and social anthropology, with which ethnology is so closely akin as to be almost synonymous, and archæology. To the geographer man is interesting because (1) in his settlement and other activities he responds to the opportunities which his environment offers, and (2) in his response to the conditions of environment he alters the characteristics and the spatial arrangement of the phenomena which constitute the environment.

The distribution of the human population over the world is undoubtedly of legitimate interest to the geographer. How that distribution has come about, the effect it has on the pattern of phenomena within a region, and the influences which are at work to alter the distribution—these are topics which the geographer studies without challenge. In regard to the somatic characters of man, only the anthropologist speaks with authority. There are undoubted racial differences between the populations of different zones, but the description of those differences in their relation, if any, to environment might well be left to the anthropologist or ethnologist, until the causes of racial differentiation between one community and another have been much more thoroughly investigated.

The argument of this article is, in effect, a recommendation of the regional method in the study of geography. It is, indeed, more, for it suggests that there is no alternative method of approach. The geographer's unit is the region, and only by reference to it does he make his distinctive contribution.

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[1] *Scot. Geog. Mag.*, 3, 401 (1887).

TAXONOMY OF THE MOTHS INFESTING STORED FOOD PRODUCTS

By DR. A. STEVEN CORBET
British Museum (Natural History)

UNTIL about a quarter of a century ago, the identification of butterflies and moths was effected, almost entirely, by comparing their wing- and body-colour patterns with named material in collections or with published figures and descriptions. Inevitably, differences of opinion arose, which could not be resolved on morphological evidence, between collectors who knew the insects alive and systematists who studied them dead. The prolonged controversy about the conspecificity or otherwise of the Pierid butterflies *Catopsilia crocale* (Cramer) and *C. pomona* (Fabricius) in the Oriental region is a case in point[1].

Although it is more than a century ago since Rambur[2] showed that the male genital organs were a satisfactory criterion for separating the superficially very similar species of butterflies in the group allied to the British 'grizzled skipper', *Pyrgus malvæ* (Linnæus), it is only within the last forty years or so that other investigators, such as Rothschild and Jordan, Chapman, and Pierce, began to investigate the genitalia of certain lepidopterous groups in which they were interested. The male genitalia—or, more precisely, the male external genitalia—consist of an assemblage of paired and median structures, usually heavily chitinized, that come into operation during the act of copulation. It became evident that, while not entirely immune from variation, the characteristics of these organs were much less subject to modification than were those of the colour pattern and other characters previously used for specific discrimination. In the majority of cases the specific features of the male genitalia were found to remain practically constant throughout whole series of insular geographical races, even among species where the wing patterns of some of the constituent races were quite dissimilar.

In practice, most attention has been paid to the characteristics of the genitalia of the male, which are more complex than those of the female, and so have greater potentialities for displaying differences in shape and size of the constituent parts. The simpler female external genitalia appear to show fewer specific differences and, in point of fact, seldom show any among closely related species when the genitalia of the corresponding males are devoid of specific distinctions.

The use of the genitalia to prove the conspecificity of geographical races showing markedly different superficial characters has been mentioned above. The converse situation occurs in which the uniformity of superficial characters of colour pattern, etc., point to the conspecificity of specimens from a wide geographical range, while the genital characters separate them into a series of distinct groups corresponding to different geographical localities. Thus, in a remarkable case known to me[3], the Lycænid butterfly *Pratapa anysis* (Hewitson) shows no marked differences in its superficial characters throughout its range from Nepal, through Burma and Malaysia, to the Celebes, but, on the basis of the male genitalia, the specimens fall into clearly differentiated groups which correspond exactly with the geographical subregious found in the range of the species. It may be added that these differences are of a degree found elsewhere in the genus only between distinct species.

The examination of the genitalia is not a universal panacea for problems in the taxonomy of the Lepidoptera. There are cases, particularly among the Pierid and Danaid butterflies, where related but undoubtedly distinct species have the genitalia structurally indistinguishable. However, even after allowance has been made for these exceptions, the fact remains that the genitalia afford the most reliable means of specific discrimination for the vast majority of the Lepidoptera.

With the moths, progress has lagged far behind that with the butterflies. A notable contribution has been the work of Pierce[4] and his collaborators, who have figured the male and female genitalia of all the British species of Lepidoptera with the exception of the minute leaf-mining Nepticulidæ. The European species of this latter family have been similarly investigated by Petersen[5]. Only in the family Sphingidæ ('hawk moths') have the male genitalia of the species of the whole world been comprehensively studied and figured (Rothschild and Jordan[6]).

Almost always, the examination of a group on the basis of the genital structures results in an increase in the number of recognized species, many former species being revealed as 'species-complexes' consisting of an assemblage of species distinct in respect of their genitalic characteristics, but possessing the same general facies as regards colour pattern, etc. There are a few instances where examination of the genitalia has led to a reduction in the number of species recognized; thus, in the Danaid genus Euploea Fabricius of the Indo-Australian and African regions, the number of listed species has been cut to a third of its former dimensions.

This systematic technique—the examination of the characteristics of the external genitalia—is not a tool reserved for those interested in the speciation and distribution of the larger and more conspicuous Lepidoptera. It is available for application to the smaller species of moths which directly affect the affairs of mankind and hence are of immediate concern to the economic entomologist. Without accurate knowledge as to the specific status of the material which is the subject of experimental work, research in quest of methods of eliminating or controlling these noxious moths will rest on a flimsy foundation. While results obtained by an empirical or semi-empirical process may lead to successful methods of control in some cases, it is only possible to bring research to full fruition and to marshal all the potentialities of the discoveries made if the data used for the identification of the species is based on careful systematic work employing an up-to-date technique.

The War has served to throw emphasis on moths the larvæ of which infest stored food products, and it became apparent that our knowledge of the systematics of these insects was very far from complete. A reinvestigation of the taxonomy of the species of moths involved was initiated, therefore, by the Department of Entomology at the British Museum (Natural History) and was carried out by me, in collaboration with W. H. T. Tams. The full results of this investigation are in course of publication[7], although the main discoveries made in respect of the commoner moths have been incorporated in a pamphlet in the Economic Series issued by the Museum[8].

Of these moths of economic importance, only the

Pyralid genera Ephestia Guenée and Plodia Guenée had been worked out satisfactorily[9], but, even in this group, it has recently transpired that one of the commoner species is, in fact, a species-complex. In other groups, the work carried out at the British Museum has shown that, as was expected, yet other species-complexes are present. This is the position with such well-known insects as the 'large tabby moth', *Aglossa pinguinalis* (Linnæus); the 'honey moth', *Achroia grisella* Fabricius; the 'corn moth', *Tinæa granella* (Linnæus); and the 'white-tip clothes moth', *Trichophaga tapetzella* (Linnæus), and it is highly probable that, were more adequate material available for study, the position of other species would be found to be similarly complicated. In some of these species-complexes, the two or more closely related species fly together, whereas in others it would seem that the overlap in the distribution is of a comparatively recent date; the latter may constitute examples of geographical races becoming established as separate species. In the British Museum there is a paucity of material from America; but the impression has been gained that the apparently similar New World forms are by no means always so closely related to the Old World species as is generally supposed.

Often the differences in the genitalia between these closely allied species are small although constant, but, judging by the position in groups of which a sufficiency of specimens is available, it is usually possible to correlate some distinctive features in the wing pattern with these differences in the genitalia. With certain species, at present, an examination of the male genitalia is the only certain means of identification, particularly with rubbed specimens which often constitute the material available.

The important question arises as to whether the species of moths in these species-complexes, which differ constantly almost only in the genitalia, exhibit differences among themselves in the earlier stages, and in the larval food and habits. As yet, we have little exact information on this subject; but it may be remarked that, of the four closely allied species in the *Tinæa granella* complex, although *T. granella* (L.), *T. infimella* Herrich-Schäffer and *T. cloacella* Haworth are so similar in wing pattern that identification of a single specimen may be impossible without recourse to examination of the genitalia, only the larvæ of *T. granella* and *T. infimella* have been found infesting grain, although all three species, together with the quite similar *T. ruricolella* Stainton, are known to utilize certain species of fungi as the larval food material. Moreover, it appears that *T. granella* prefers wheat, while *T. infimella* favours rye: although this latter species is a pest of stored wheat in Scandinavia, it has not yet been found infesting grain in Britain. A dissimilarity in larval behaviour is found in the two rather similar species of *Ephestia*, *E. sericarium* Scott (= *kühniella* Zeller), well known as the 'Mediterranean flour moth' or 'mill moth', and *E. elutella* (Hübner), the 'cacao moth'. The mill moth is a notorious pest in flour mills throughout the world, the larva feeding on flour at all stages in the milling process and constructing webbing which eventually impedes the operation of the machinery to such an extent that fumigation of the mill is necessary. On the other hand, the larva of *E. elutella* attacks the whole wheat grain, but shows a partiality for the germ: this species is also a well-known pest of other food products such as dried fruit, cacao beans, etc.

Much work remains to be carried out in this field of economic entomology, but it is clearly essential that the taxonomic studies should first be completed. It is a waste of time to attempt to investigate the life-histories and habits of living material consisting of a complex of unresolved species. Although the work at the British Museum has placed the systematics of the food products moths on a reasonably firm foundation, there are still a few threads to be unravelled, and, doubtless, quite a host of names remains to be added to the lists of synonyms.

It may be added as a matter of interest that recent work on the chætotaxy of the lepidopterous larvæ infesting stored food products carried out at the British Museum by Dr. H. E. Hinton[10] has shown that, with a number of species, identification of the larvæ is easier and more certain than is the case with the adult moths.

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[2] Rambur, P., "Faune entomologique de l'Andalousie," **2**, 312 (1840 **42**).

[3] Corbet, A. S., *Proc. Roy. Ent. Soc. Lond.*, (B) **7**, 166 (1938).

[4] Pierce, F. N., "The Genitalia of the Group Noctuidæ of the Lepidoptera of the British Islands" (Liverpool, 1909), followed by similar monographs on the other major groups.

[5] Petersen, W., *Stett. ent. Z.*, **91**, 1 (1930).

[6] Rothschild, Lord, and Jordan, K., *Nov. Zool.*, **9** (supplement), 1–972 (1903).

[7] Corbet, A. S. and Tams, W. H. T., *Proc. Zool. Soc. Lond.* (B), **113**, 55 (1943).

[8] Hinton, H. E., and Corbet, A. S., "Common Insect Pests of Stored Food Products", British Museum (Natural History), Economic Series, No. 15 (1943).

[9] Richards, O. W., and Thomson, W. S., *Trans. Ent. Soc. Lond.*, **80**, 169 (1932).

[10] Hinton, H. E., *Bull. Ent. Res.*, **34**. No. 3 (in the press) (1943).

OBITUARIES

Prof. Isidor Traube

THE death of Isidor Traube at Edinburgh at the age of eighty-three brought to a close a life of great significance to present-day exponents of physical and colloid chemistry. Born at Hildesheim of Jewish parents (his father was a merchant), Traube entered the University of Berlin in 1879, where he studied chemistry under A. W. Hofmann and physics under Helmholtz. Later he worked in the physiological institute of Du Bois Reymond, and was awarded his doctorate for a thesis in the field of organic chemistry. After a period of military service, which appears to have been little to his liking, he became for a period assistant to Bernthsen. Contact with Bunsen and Hermann Kopp turned his thoughts to the then embryonic science of physical chemistry and in particular to the phenomena of solution, adhesion and cohesion, to the study of which so much of his life was later to be devoted.

Greatly impressed by the experimental results of Raoult, Traube's speculative mind early recognized the relation between the gas laws and Raoult's empirical laws relating to dilute solutions; he was aware also of the implications regarding the dissociation of the electrolytes to which many of Raoult's data referred. Unfortunately for Traube, instead of publishing his interpretations of these results (his paper would have anticipated van't Hoff by two years), he communicated them (1884) to Lothar Meyer, then professor of chemistry at Tübingen. Meyer, unimpressed by the accuracy of the Frenchman's data, which in his opinion required further substantiation, cautioned the young Traube against hasty publication. The papers of van't Hoff and Arrhenius were published in 1886–87.

After a short interval in Heidelberg, Traube migrated to Bonn, where he worked as assistant at the Agricultural Academy. It was there that he began his studies of the viscosities and surface tensions of liquids. So early as 1891 he expressed the opinion that the molecules forming adsorbed films at the surfaces of solutions obey equations of state analogous to those of three-dimensional gases, the area per molecule being the analogue of the molecular volume, and the lowering of surface tension that of the gaseous pressure. This time Traube anticipated the march of scientific opinion not by two but more nearly by thirty years, for it was not until the impetus given to the study of surface phenomena by Hardy, Langmuir and Harkins had made itself felt that the correctness of his view was firmly established by Adam (1921), Volmer (1925) and others.

Already in 1885 Traube had shown that with members of a homologous series dissolved in water (for example, the lower alcohols or the alkyl acetates) equal lowerings of the surface tension of the water were produced by concentrations which decreased *geometrically* about three-fold for each additional CH_2. In much later work he extended a form of this generalization (Traube's rule) to adsorption at liquid/liquid and solid/gas interfaces, although he was careful in this last case not to confuse the affinity or free energy of adsorption, to which the rule would apply, with the saturation capacities of the surface, to which it would not.

Traube found a practical outlet for these discoveries in the assessment of the fusel oil contents of spiritous liquors. He also applied his theories of film formation and surface activity to explain the viability of drugs in living tissues (1904). Ever since its formulation, Traube's theory of drug action has exercised a profound influence on pharmacological research, and perhaps to-day more than holds its own against the rival lipoid solubility hypothesis of Overton and Meyer. Traube's other studies included such diverse subjects as the molecular volumes and intrinsic pressures of pure liquids (1895–1920), the theory of critical phenomena (1902), colloidal gold, the theory of catalysis (1913), the stability of matter in the submicronic state of division (1928–29) and the froth flotation of minerals and of organic chemicals.

A careful experimenter and possessing an exceptionally penetrating mind, Traube was never over-elaborate either in his laboratory techniques or in his formulation of theories. Unlike those of his great contemporaries, Nernst and Ostwald, his writings were never pontifical, and, so far from their becoming current dogma, it was left to later generations of chemists to appreciate their essential merit.

After holding for a third of a century the title of 'extraordinary' professor at the Technische Hochschule, Berlin, Traube came as an *émigré* to Britain in 1934. He settled in Edinburgh, where he was welcomed as a guest of the University. Active-minded to the last, he completed shortly before he died the manuscript of a book of reminiscences. To this and to his surviving daughter, Dr. S. Boas-Traube, I am indebted for the biographical details given in this note. D. H. BANGHAM.

WE regret to announce the following deaths:

Mr. J. S. Addison, deputy chairman of Courtaulds, Ltd., and chairman of the scientific advisory committee of the Empire Cotton Growing Association, on December 15.

Mr. Edward A. Martin, formerly secretary of the South-Eastern Union of Scientific Societies, on December 14.

Mr. H. F. Witherby, M.B.E., the well-known ornithologist and publisher of works on natural history, on December 11, aged seventy-three.

NEWS and VIEWS

A Programme for Reconstruction

THE statement, "Forward—By the Right", issued by the Tory Reform Committee (Pp. 16. Tory Reform Committee, House of Commons, London, S.W.1), is of considerable interest to scientific workers as indicating principles and objectives on which there is a large measure of general agreement, however widely opinions may differ as to the measures by which the objectives are to be attained. Eight principles are enunciated and illustrated: national unity; empire unity; the interdependence of nations; the full development of resources; the practical approach; individual freedom; trusting the people; and finally, that of first things first. Much general support will be found for the view that in Imperial affairs attention should be transferred from abstract questions of political status to such practical problems as Imperial defence, air and sea transport, broadcasting and communications, education, research, economic development and migration. In regard to the interdependence of nations, it is urged first that those military organizations for consultation and joint action which exist between the United Nations should be maintained, and also those organizations such as the Middle East Supply Centre which could be adapted to the needs of peace and assist in removing the causes of dispute. The International Labour Office and the Hague Court should be revived and such joint enterprises as are exemplified in the Hot Springs Conference developed. While mutual co-operation and understanding between the British Commonwealth, the U.S.A., the U.S.S.R. and China must form the basis for establishing a framework of stability, the final framework of any world organization will require a broad foundation.

Under the development of resources, the Statement, after emphasizing the necessity of a policy of full employment, including Empire development, agriculture and the development of exports, calls for the devotion of far greater resources in men and money to scientific and technical research, including provision in the educational system of Great Britain for the increased numbers of trained scientific workers required. On the question of planning, the Statement is not clear, but it emphasizes the necessity both of ample statistical and other information as a basis, as well as ensuring that the objectives of policy command general support. Dealing with public control, it is advocated that the public interest should be the decisive test; private profit is not accepted as the sole test of public advantage. The peacetime essentials are regarded as, first, the retention of adequate armaments and compulsory military training; secondly, full employment as a condition of individual self-respect and independence, and as a guarantee that the maximum effort is being harnessed to the national objectives; thirdly, the provision of homes for all of an adequate standard; fourthly, the establishment of an educational system which will enable any child to develop his capacities and character to the full; and fifthly, social security guaranteed by adequate minimum wages and a system of social insurance on the lines proposed by Sir William Beveridge.

Transport Problems in Reconstruction

SUPPLEMENTING two earlier broadsheets, Nos. 202 and 207, on "Retail Distribution and Town Planning" and on "Space for Leisure", respectively, Political and Economic Planning has now issued a further broadsheet in its attempt to analyse the needs of the consumer which physical planning should satisfy. This broadsheet, "Use and Misuse of Transport" (No. 211), reviewing first the general problems of pre-war transport in Great Britain, including the mounting delays, excessive journeys, travelling to work and the consequent loss of time, points out that if the full social costs are taken into consideration, the value of a great proportion of the transport which has been considered as normal is not commensurate with the price paid for it in money, time, energy, ill-health and loss of amenity. The position could not have been allowed to drift for many years longer without a real crisis developing. Dealing first with the comparatively limited question of reducing pressure on the roads, the broadsheet emphasizes that if travel by public vehicles in place of private car or vehicles is to be encouraged, accessibility is the key to the whole problem. More parking space and legal recognition of joint ownership of a car, the development of retail delivery services, and the utilization of any possibilities of underground travel as well as travel by air, are suggested; and the broadsheet gives a warning against allowing ourselves to be left behind in utilizing the air, as we were by the rapid development of the internal combustion engine.

The major possibilities, however, lie in the reduction of the demand for transport. The wider utilization of piped services and of the telephone in eliminating journeys is obvious, but the decentralization of services and amenities so as to rectify serious mistakes originally made in housing estates is also important. The major problem is that of reducing the journey to work, but there are limits to the alleviation which local employment can provide in this respect, and the broadsheet analyses closely the possibilities which zoning offers, particularly in regard to segregating traffic. Six different types of zone are enumerated, and discussing their interrelation, the broadsheet suggests that industry, warehouses and wholesale markets should be placed on the outskirts of a town; living quarters, offices, shops and schools would then be kept free from the intrusion of heavy traffic. Recent plans for large towns have shown a tendency in this direction. Such zoning, however, leads to the question whether synthesis is possible between the principles of the neighbourhood unit in which people's lives are localized, and of zoning, which is recommended for reasons of economic efficiency, of amenity and of a rational arrangement of transport. The problem of securing employment for people near their homes is more intricate than the decentralization of services and leisure facilities. While it is important that the light mobile industries should account for a much higher proportion of total employment, the issues cannot be decided purely from the point of view of transport, and a broad approach to this very broad problem is essential, as well as vision and boldness.

Association of Scientific Workers of Southern Africa

THE success achieved by the Association of Scientific Workers in Britain, the United States, and Australia, has inspired the establishment of a similar Association recently in South Africa, under the title of the Association of Scientific Workers of Southern Africa. Various problems such as the recent and still incomplete industrialization of the country, the widely scattered population, and the great distances between the few considerable urban and industrial centres, have necessitated an approach to problems of organization and policy differing a good deal from those adopted in Britain to achieve the same fundamental aims of promoting the application of science and the scientific method to the welfare of mankind, while at the same time furthering the professional interests of scientific workers. Also, the statutory position of a trade union is quite different in South Africa from that in Britain.

The establishment of the Association in South Africa met with a good response. The two branches, Johannesburg and Cape Town, now have a joint membership from all parts of the Union and the Rhodesias of more than 350. Public conferences have been arranged and have attracted considerable attention. Memoranda have been presented to the Government Health Services Commission, and the Social and Economic Planning Council, and for publication, on various problems concerning the application of science to national problems. Recently the Association co-operated with the Medical Council in the matter of registration of laboratory technologists, who now form a large and enthusiastic group within the Association. The Association is also at work through special sub-committees, on war emergency problems, education, research, finance and organization, and similar problems. It is expected that further branches will be established in the near future. The chairmen and addresses of the two existing branches are P. S. Malan, P.O. Box 1065, Cape Town, and Rena G. Knight, P.O. Box 8083, Johannesburg.

Scientific Film Association

THE Scientific Film Association was formally constituted at an extraordinary general meeting held on November 20. The primary aim of the new Association is to promote the national and international use of the scientific film in order to achieve the widest possible understanding and appreciation of scientific method and outlook, especially in relation to social progress. It will also collect, collate and distribute information on the scientific film, and publish comprehensive lists of films graded according to scientific merit and suitability for audiences. The Association hopes to establish relations with Government departments, public bodies and other organizations which are in a position to make, use or circulate scientific films; and it is also proposed to organize a representative panel of men of science to advise producers of films of all types on scientific matters in connexion with such films and to maintain close contact with the film industry. All inquiries should be made to M. Michaelis (honorary secretary), 51 Fitzjohn's Avenue, London, N.W.3.

Prehistory in the Deccan

So long ago as 1930, in the September number of *Antiquity*, Mr. M. C. Burkitt made an attempt to set out in some order the early archæological discoveries of south-east India. The bases for the study were the finds and notes made during a long period of years by Mr. L. A. Cammiade over a wide area of country including the districts along the lower reaches of the Godavari River. Actually, the finds made near this river were all from the surface and could not be accurately dated. They were, however, mostly microlithic in character; but it was clear that many ages were represented. Mr. H. D. Sankalia has now published a short article, "Studies in Prehistory of the Deccan (Maharashtra): a Survey of the Godavari and the Kadva near Niphad" (*Bull. Deccan Coll. Res. Inst.*, **4**, No. 3) which, while not taking us much further, has a certain interest. Briefly, the Godavari has, in places, cut down through the trap to a low level, having previously deposited on the trap a series of gravels in which Mr. Sankalia has discovered a few artefacts *in situ*. Unfortunately, the illustrations are not very good, and it does not appear that any outstanding finds have been made, but Mr. Sankalia is to be congratulated on having started an investigation which eventually may prove to be of considerable interest. It must always be remembered that the well-known micro-industries of the rock shelters in the Central Provinces of India, far from corresponding to the Mesolithic industries of Britain, are apparently for the most part post-Christian in date. At the same time there are post-Middle Stone Age finds of small implements in the Cammiade collection which probably do date to Late Pleistocene times. Further work by Mr. Sankalia may help to elucidate these problems.

St. John's Wort in Australia

St. John's wort (*Hypericum perforatum* var. *angustifolium*), introduced into Australia in about 1880 as a garden plant, is now a serious weed in many parts of that country. Besides reducing the carrying capacity of the pasture, stock may become affected with 'wort dermatitis', for the hypericin in the plant acts on the nervous system, rendering the exposed non-pigmented areas of their skin photosensitive. Control measures of various kinds are being tried, including improvement of the pasture by sowing competitive species, chemical treatment and the liberation of insect parasites. Some account of the success attending these trials is given in recent publications of the Australian Council for Scientific and Industrial Research. Bulletin 151 consists of a paper by R. M. Moore and A. B. Cashmore, who have investigated the problem from the agrostologist's point of view, while the entomological aspect is specially dealt with by F. Wilson and T. G. Campbell in the Council's *Journal* (**16**, p. 45). The results are most promising. Subterranean clover (*Trifolium subterranean*), a winter-growing annual, proved an efficient competitor with St. John's wort, and in association with perennial grasses, such as *Phalaris tuberosa* or *Lolium perenne*, almost completely eradicated the weed and provided a productive and nutritious pasture. The mixture is best sown with a dressing of superphosphate after a summer fallow, a dense pasture being afterwards maintained by regular top-dressings and a rotational system of grazing. The use of dark-coloured stock is also recommended as they are less prone to wort dermatitis. For entomological control, three insects have been established in Australia, two leaf-eaters, *Chrysolina hyperici* and *C. gemellata*, and a root-boring Buprestid, *Agrilus hyperici*. The prospects of success are good, particularly with Agrilus, as it is remarkably free from predators and parasites, but the Chrysolina species have a high reproductive rate, and judging from experience in France, all three insects can play a useful part in the control of the weed.

Stellar Spectrophotometry in the U.S.S.R.

Two recent publications (*Bull. Acad. Sci. Georgian S.S.R.*, **3**, No. 6, p. 509; No. 7, p. 657; 1942) give news that astrophysics still flourishes just beyond the high-water mark of the German advance into southern Russia. At Abastumani Observatory an extensive programme of photo-electric colorimetry of $B8$–$B9$ stars was begun in the summer of 1940 and is still in progress. The colours of all stars of these spectral types brighter than 7·5 mag., lying in a zone within 20° of the galactic equator, are being measured with an antimony-cæsium photo-cell attached to a 33 cm. reflector. Colour filters give effective wavelengths of 4060 A. and 5280 A., the resulting colour equivalents being on a base-line slightly longer than ordinary photographically determined colour indexes. The greater sensitivity, range and stability of the antimony-cæsium cell enables the Russian observers, V. Nikonov and E. Brodskaja, to obtain observations of which the probable error is less than $\pm 0{\cdot}01$ mag. for stars brighter than the sixth magnitude, and less than $\pm 0{\cdot}02$ mag. for the fainter stars. When full results of this programme are available, they should add greatly to our knowledge of the selective absorption of light by interstellar matter situated fairly close to the sun.

Meanwhile, a vexed point regarding the colour temperature of α^2 CVen is being investigated at Mt. Kanobili. Thirty-three observations of the star taken in the spring and summer of 1941 show a maximum variation of colour temperature of 2,000°, which agrees better with the spectrum changes than the value of 10,000° found by Tai (*Mon. Not. Roy. Astro. Soc.*, **100**, 94; 1939). A puzzling feature of the observations is that the star is bluer at minimum than at maximum, a characteristic which differentiates it sharply from such intrinsic variables as Cepheids and long-period variables. Observations are being continued at Abastumani in happier circumstances than any obtaining since the inception of the programme.

South African Institute for Medical Research

The annual report for 1942 of the South African Institute for Medical Research in Johannesburg indicates that this progressive Institute is playing its full part in the war effort. Staffed by 153 Europeans and 118 Africans, its activities are wide. In 1942, its buildings, which were no longer adequate to the large demands for serum for civilians and for army needs, were enlarged; a branch laboratory was established at Bloemfontein. The erection of a large plant for the manufacture of dried human and other serum was made possible by a grant of £10,000 from Sir Ernest Oppenheimer and the Anglo-American Corporation of South Africa. The production of vaccines and sera for the troops has been very greatly increased; staff are being trained for the administration of military hospitals and for their laboratories, and two mobile laboratories and nineteen military hospital laboratories have been established in the Union. Special military medical problems are being investigated. Other war activities of the Institute include vitamin assays, food analyses for military needs, the production of anti-gas-gangrene serum, the study of insect vectors of disease, plague, relapsing fever, typhus and yellow fever. The list of other researches being done is impressive, and the Institute's routine diagnostic work is evidently one of its most important activities.

Rapid Disappearance of Smallpox

According to the May issue of the *Statistical Bulletin*, the organ of the Metropolitan Life Insurance Company of New York, in 1942 for the first time in the history of the United States the number of smallpox cases fell below 1,000. Eleven States were entirely free from the disease, and three other States reported only one case each. Texas alone had more than 100 cases. During the whole year there were less than ten smallpox deaths. In Canada there were only six cases and no deaths. The 897 cases of smallpox reported in the United States in 1942 showed a marked decline from the previous low record of 1,446 cases in 1941 and were only a fraction of the number for 1940, 1939 and 1938, when the cases numbered 2,797, 9,877 and 14,977 respectively. In an outbreak of 65 cases in Pennsylvania, the patients had either not been vaccinated or had long outlived their immunity. Apart from 13 unvaccinated school-children, the victims were past middle age.

Production of Rubber in Europe

A short notice of an article in *Agricultura* (128, Dec. 1942) entitled "La producción de caucho en Europa" appears in the *Revista De Formacion Y Documentacion Profesional* (No. 7; 1943). It is pointed out that in the Mediterranean basin it is possible to cultivate plants from which a secretion having the characteristics of rubber has been extracted. This question attained great importance after the occupation of the Ukraine by the enemy, because large tracts there were devoted to the cultivation of *koksagyz*, a dandelion-like plant, from which it is claimed that fairly satisfactory rubber could be obtained; the percentage of rubber from the extract was as high as 27. The article suggests that, if to this are added the species which can be cultivated in the Mediterranean basin, and also the synthetic rubber manufactured by the Germans at the Buna works, a possible solution of the natural rubber supply for European countries would be forthcoming.

Maintenance Work in Electrical Supply

A paper on "Maintenance of Distribution Plant and Mains on A.C. Networks" was read before the Institution of Electrical Engineers in London on November 10 by Messrs. F. N. Beaumont and F. A. Geary. They stated that the frequency with which apparatus should be examined, and the time to be allocated for each overhaul, are dependent on (*a*) the design of the individual unit in relation to its electrical duties and the atmospheric conditions under which it has to operate; (*b*) the electrical and mechanical strength of the materials employed; (*c*) the accessibility of the parts requiring normal inspection and testing; and (*d*) the physical lay-out and housing of the units, together with the facilities available for carrying out routine maintenance on site. The closest co-operation between the designer and the maintenance engineer is at all times desirable, in order that those details in design which require excessive maintenance may be suitably modified. It is the function of a maintenance engineer to organize the necessary maintenance, examination and testing of all sections of plant under his control, so that the plant may carry out its functional operation successfully and incipient faults be found and eradicated before they lead to failure on the line. The aspects and items of equipment dealt with in the paper are as follows. Staffing, safety precautions, record systems of plant maintenance, switchgear maintenance, batteries, transformers, transformer chambers, fire-fighting installations, protective gear and mains. The paper shows that maintenance, combined with adequate records, can foster improved design, to the mutual advantage of manufacturer and user, in order to obtain for future purposes the best design and lay-out practicable.

Electricity in Mines

A review of this subject given (*J. Inst. Elect. Eng.*, 90, Pt. 1, No. 34; October 1943) by Mr. J. A. B. Horsley covers the use of electricity in mines under the Coal Mines Acts which are operative in Great Britain. The review gives certain statistical data and surveys technical developments, British Standard specifications, effect of recent legislation, and future developments.

Literature of Penicillin and Similar Substances

Last September the National Research Council of Canada issued "Abstracts on Penicillin and other Antibiotic Substances" (National Research Council, Ottawa: No. 1160. 1.00 dollar). Compiled by Miss Muriel E. Whalley, of the Research Plans and Publications Section, it arranges by authors 185 abstracts taken from the *American Chemical Abstracts* (1917 to Sept. 10, 1943, inclusive) and other material found in the library of the National Research Council of Canada. An index increases the usefulness of this publication and Miss Whalley is to be congratulated on her work. The abstracts deal with the chemical and biological properties of sixteen substances in all. Eight of these are obtained from bacteria, eight from fungi. Among the latter are penicillin, penatin and fumigacin, some of the properties of which have been noted in these columns recently. The properties of patulin were made known too late to be included in Miss Whalley's very useful compilation. As we go to press we learn from the *British Medical Journal* (Dec. 18, 1943, p. 800) that the January number of the *British Medical Bulletin* will be devoted to authoritative articles on, and a bibliography of, penicillin.

Rediscovery of Comet Daniel (1909 IV)

This comet was seen by Mr. G. F. Kellaway, West Coker, on Nov. 30d. 22h., and a few nights later his photographic results confirmed the position which he had adopted for it. Its magnitude at the time of discovery was 13, and it was very close to the place predicted by Mr. W. P. Henderson and Dr. H. Whichello, in the "Handbook of the British Astronomical Association", 1943.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Flow States in Emergent Gas Streams

As part of a study of factors affecting flame stability, some time ago we began an investigation into the influence of gas velocity on the flow conditions at a burner head; in the first instance unignited media were employed. The technique of instantaneous shadow photography was chosen as best for the purpose, and a preliminary series of experiments showed propane or butane as most suitable gaseous media; for, not only do the refractive indexes of these hydrocarbons differ widely from that of air, but, in addition, their immobility enhances the sharpness of the gaseous boundaries and the consequent clarity of the photographic records.

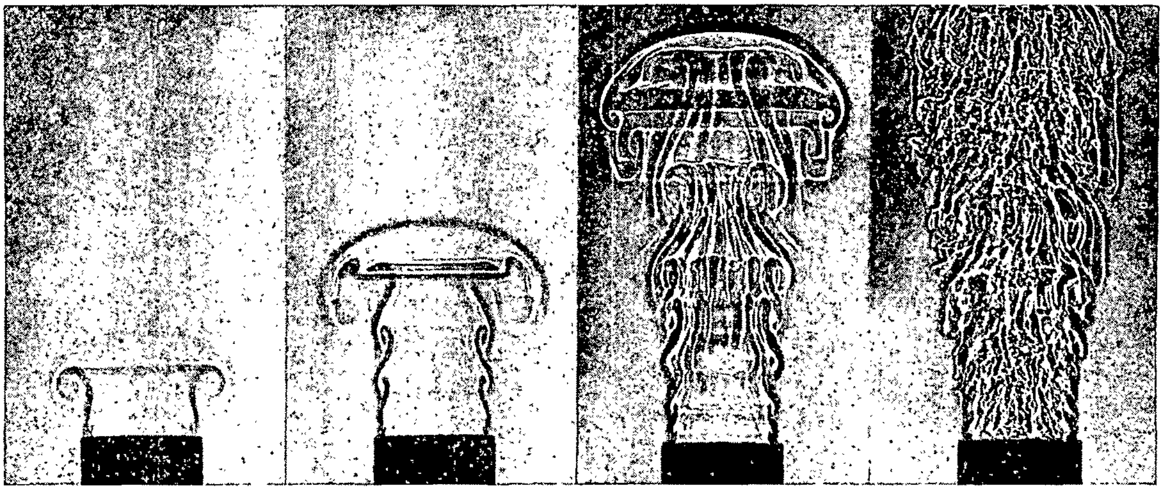
The accompanying photographs were obtained at intervals of 1/50 sec. after releasing propane abruptly from its confinement through a ⅜ in. diameter tube some 40 in. in length, the velocity of the stream increasing from zero to that adequate for turbulence.

Figs. 1 and 2 indicate the primary vortex, known as 'Overbeck's vortex', conditioned by the initial expansion of propane into the surrounding atmosphere; this is followed at successive intervals by secondary vortices. Previous records of such flow, though less clearly defined, have been obtained by F. C. Johansen[1] using liquids, by G. Burniston Brown[2] using illuminated smoke streams emerging from narrow rectangular orifices, and also at the National Physical Laboratory[3], where air intermittently heated by sparks was used.

Fig. 3 indicates a transition flow state before the attainment of velocities adequate to induce turbulence (Fig. 4). Under such conditions the rising column appears to become segmented and is possibly rotating.

Our present experience indicates that while the primary vortex is a common phenomenon at all speeds below the minimum for turbulent flow, secondary vortices develop more slowly the slower the gas velocity, the distance above the orifice for a given degree of development appearing to vary somewhat inversely with velocity; also, the higher the velocity the more closely does the first secondary vortex approach the sphere of action of the primary vortex. The development of the primary vortex is also accompanied by narrowing of the main stream, due to a transfer of gas. Under the conditions described, there are doubtless velocity and pressure gradients at the front of the stream; with the attainment of steady flow, the secondary vortices are less mature on emergence but develop abruptly, at distances above the port decreasing with increasing gas velocity.

The secondary vortices are of particular interest to us as, when developed, it would appear that they are the most likely source of the periodic expansions and contractions of the outer cone of a bunsen flame revealed either by Schlieren photography[4] or stroboscopically[5]. Also, when a non-aerated flame at an adequate feed velocity leaves a burner port but remains stationary some distance above, it appears to be sealed at the locus of rapid development of the secondary vortices.



1 2 3 4

Brown attributed the secondary vortices to the sensitivity of the stream to sound motions arising autogenously; indeed, he demonstrated their inducement by suitable sound waves from an extraneous source.

We are giving further consideration to some of the issues raised.

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Dept. of Coal Gas and Fuel Industries,
University of Leeds. Nov. 26.

[1] Johansen, F. C., *Proc. Roy. Soc.*, A, **126**, 231 (1929).

[2] Brown, G. Burniston, *Proc. Phys. Soc.*, **47**, 703 (1935).

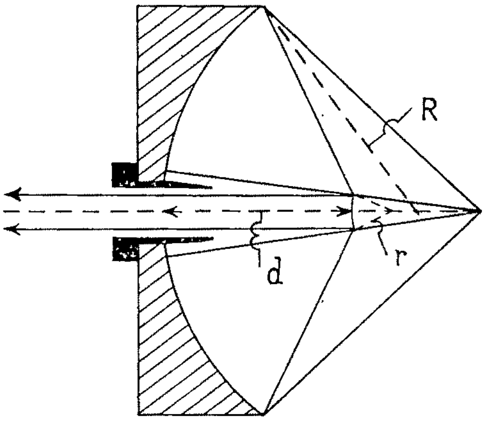
[3] Annual Report, 1935, p. 179.

[4] Gawthrop, D. B., cf. Lewis, B., and von Elbe, G., "Combustion, Flames and Explosions of Gases", p. 153.

[5] Hartley, H., *Trans. Inst. Gas Eng.*, **82**, 466 (1932–33).

Reflecting Microscopes

I have read with particular interest the letter of E. M. Brumberg *et al.*[1] mentioning the use of a reflecting microscope involving two spherical mirrors since I have myself made three reflecting objectives; one of these was shown in process of figuring (N.A. 0·58) and one completed (N.A. 0·65) at the Physical Society's Exhibition in 1939. I used non-spherical



mirror-pairs, Schwarzschild aplanats[2,3], for a reason which may prove important if it is desired to exploit fully the possibilities of reflexion microscopy—I wished to reduce the fraction of the numerical aperture obstructed by the convex mirror.

Some astronomers say that though obstructing the central third of the numerical aperture of a telescope objective does not much hinder the resolution of a double star, and may even help it if the components are about equally bright, the effect on the resolution of a very unequal double is deleterious, and the effect on the visibility of low-contrast planetary detail markedly so[4]. They suggest that the 'obstruction ratio' should not be allowed to rise above 0·2, and should preferably be lower.

The bispherical monocentric approximation to the Schwarzschild aplanatic pair has an obstruction ratio of about 0·447. To reduce this while at the same time preserving exact anastigmatism, we must choose a pair in which both mirrors are non-spherical. If we are prepared to tolerate a moderate astigmatic coefficient, we need only figure one of the mirrors, provided the numerical aperture does not exceed about 0·65. To make such an aplanat (see figure) choose the ratio of radii of curvature of the mirrors to give the desired obstruction ratio: adjust the distance between them to the tabular value for freedom from coma, and figure the concave mirror to remove spherical aberration, continually readjusting the distance between the mirrors during figuring to preserve freedom from coma: this adjustment is very critical, and must be determined empirically. Fortunately it may be used to compensate for the spherical aberration produced by a cover-glass, without introducing serious coma. The table below assumes infinite tube-length, but will form an approximate guide when the tube-length is finite.

Intrinsic obstruction ratio	0·447	0·286	0·219	0·131
Radius of concave mirror, *R*	3·236	6·22	8·92	16·8
Radius of convex mirror, *r*	1·236	1·28	1·31	1·33
Approximate distance between mirrors, *d*	2·00	4·45	6·72	13·3
Approx. astigmatic interfocal distance in object space, at off-axis height *H*	0·00	$0\cdot142\,H^2$	$0\cdot209\,H^2$	$0\cdot270\,H^2$
Focal length	1·00	1·00	1·00	1·00

Only actual experience with different kinds of microscopic object and different methods of illumination can decide whether there is a benefit due to reduced obstruction which is worth the labour of aspherizing one or both surfaces. It may be that these two-mirror types will be abandoned in favour of D. D. Maksutov's ingenious 'solid' reflecting objective, in which the same air-glass surface, after acting as 'first mirror' by total internal reflexion, lets out the image formed by the second (silvered) surface, at normal incidence[5]. It may be found better to use the Schmidt principle: E. H. Linfoot exhibited in 1939 two Schmidt microscopes, N.A. 0·45 and 0·54[6,7]. He has since shown that a 'through-type' Schmidt microscope using two spherical mirrors exists: the Schmidt plate lies in the object-space, and can conveniently be made by aspherizing a normal-incidence 'immersion hemisphere'[8].

I have given the general condition for anastigmatism of two-mirror systems of finite tube-length in a paper in process of publication. I hope to give a fuller account of my three instruments shortly. For the present, I have had to lay this work aside; but not before I could satisfy myself with a few test slides and an eyepiece that at any rate the visual performance of these up-to-date versions of the ancient 'compound reflecting engiscopes' is substantially the same as that of their refracting counterparts.

C. R. BURCH.

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Nov. 10.

[1] Brumberg, E. M., NATURE, **152**, 357 (1943); *C.R. Acad. Sci. U.S.S.R.*, **25**, 473 (1939); **31**, 658 (1941); **32**, 486 (1941).

[2] Schwarzschild, "Theorie der Spiegelteleskop" (Göttingen Observatory, 1905).

[3] Chrétien, *Revue d'Optique* (Feb. 1922)

[4] Dall, *J. Brit. Astro. Assoc.*, **48**, No. 4, 163 (1938).

[5] Maksutov, U.S.S.R. Patent No. 40859, Dec. 13, 1932.

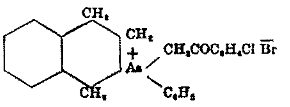
[6] Linfoot, *J. Sci. Instr.*, **15**, 405 (1938).

[7] Clay, *J. Sci. Instr.*, **16**, 49 (1939).

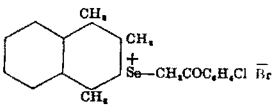
[8] Linfoot, *Mon. Not. Roy. Astro. Soc.*, **103**, No. 4, 210 (1943).

An Optically Active Selenonium Salt

WE have shown that *o*-β-bromo-ethyl benzyl bromide condenses with phenyl-dichloro-arsine in the presence of sodium to give 2-phenyl-1 : 2 : 3 : 4-tetrahydro-*iso*-arsinoline[1], which readily combines with *p*-chlorophenacyl bromide to give 2-phenyl-2-*p*-chlorophenacyl - 1 : 2 : 3 : 4 - tetrahydro - *iso* - arsinolinium bromide (I). This salt contains an asymmetric arsenic atom, and we were able to resolve it into optically active forms, the corresponding *dextro* and *lævo* *iso*-arsinolinium picrates having $[M]_D + 457°$ and $- 450°$ respectively in chloroform solution.



I



II

This use of the bromo-ethyl benzyl bromide for the synthesis of heterocyclic systems can clearly be widely extended. We find that the bromide condenses readily with sodium selenide to give seleno-*iso*-chromane, and with sodium telluride to give telluro-*iso*-chromane. The therapeutic properties of these novel heterocyclic selenium and tellurium compounds, and of their chief derivatives, are now being investigated.

Meanwhile we have combined the selenide with *p*-chlorophenacyl bromide to give 2-*p*-chlorophenacyl-seleno-*iso*-chromanium bromide (II). This compound contains an asymmetric selenium atom. We have therefore converted it into the *d*-bromocamphorsulphonate, which on recrystallization from alcohol ultimately acquired a constant rotation, $[M]_D$ −271° in alcohol. This salt in turn was converted into the 2-*p*-chlorophenacyl-seleno-*iso*-chromanium picrate, which had $[M]_D$ −496° in acetone solution, and into the corresponding mercuric tri-iodide, which had $[M]_{5893}$ −535°, also in acetone solution.

The acetone solution of the picrate retained its activity unchanged when allowed to stand at 16° for 20 hours, but underwent almost complete racemization when boiled for 1¼ hr. The solution of the mercuric tri-iodide underwent very slow racemization even at room temperature.

It is noteworthy that a dissymmetric arsonium halide such as (I) can racemize only by partial dissociation to a tertiary arsine and alkyl halide, that is, by the establishment of a 'dissociation-equilibrium' of the type $[abcd\text{As}]\text{Br} \rightleftarrows abc\text{As} + d\text{Br}$. A dissymmetric selenonium halide such as (II) can, however, racemize either by the establishment of a similar equilibrium, $[abc\text{Se}]\text{Br} \rightleftarrows ab\text{Se} + c\text{Br}$, or by direct racemization of the selenonium ion, that is, in compound (II), by direct oscillation of the *p*-chlorophenacyl radical above and below the plane of the ring. It is not unexpected, therefore, that the above selenonium picrate and mercuric tri-iodide are comparatively readily racemized.

The compound (II) is the second selenonium compound to be resolved into optically active forms: the first compound, methyl-phenyl-selenetine bromide, was resolved by Pope and Neville[2], who obtained the corresponding *dextro* and *lævo* chloroplatinates having $[M]_D$ +55° and −54° respectively.

We hope to resolve the sulphur and tellurium analogues of the compound (II), so that the rotatory dispersion of the three compounds can be compared.

F. G. MANN.
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Nov. 17.

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[1] NATURE, 151, 474 (1943).

[2] *J. Chem. Soc.*, 81, 1552 (1902).

An Antibacterial Substance from *Aspergillus clavatus* and *Penicillium claviforme* and its Probable Identity with Patulin

B. P. WIESNER, in a communication in NATURE[1] in which he acknowledges the help and advice of Prof. H. Raistrick, Mr. George Smith and Dr. Harry Coke, reported the preparation from *Aspergillus clavatus* metabolism solutions of a concentrate possessing relatively high antibacterial activity. Similar active non-crystalline concentrates were obtained from the same fungus by S. A. Waksman *et al.*[2] and investigated recently by H. W. Anderson[3].

We have isolated the active constituent from the metabolism solution of a strain supplied to us by B. P. Wiesner as a crystalline entity, from which a number of well-characterized derivatives could be obtained. Whereas Waksman called his crude active principle 'clavacin', we had adopted the name 'clavatin'. In its pure form it has m.p. 109·5–110·5° C. and forms a mono-acetyl derivative of mp. 118–120° C. Analysis and molecular weight determinations indicate an empirical formula $C_7H_6O_4$ for clavatin.

E. Chain, H. W. Florey, and M. A. Jennings[4] reported last year the isolation of a crystalline antibacterial substance from *Penicillium claviforme*, of m.p. 110° C., for which they suggest the name 'claviformin'. We have prepared claviformin according to the above authors and established its identity with clavatin by the usual chemical methods.

In a publication by Raistrick *et al.*[5] the isolation and chemistry of patulin from *Penicillium patulum* Bainier is described. In view of the close similarity of physical, chemical and biological properties of patulin and clavatin and of their derivatives, tabulated below, it is highly probable that these two substances are identical.

	Clavatin	Patulin
Empirical formula	$C_7H_6O_4$	$C_7H_6O_4$
Melting point	109·5–110·5° C.	111° C.
Melting point of acetate	118–120° C.	118° C.
Melting point of 2:4-dinitrophenyl-hydrazone	Darkens without melting	Darkens without melting
Melting point of phenyl-hydrazone	149–150° C.	152–153° C.
Melting point of oxime	152–155° C.	—
Melting point of methyl ether	69–70° C.	—
Antibacterial activity against *Staph. aureus*	1 : 64,000–128,000	1 : 64,000–128,000

The identity is further supported by our evidence from analytical experiments, collected during the past year, many of the results duplicating the findings of Raistrick *et al.* We have also isolated a reductive degradation product of clavatin identified as β-propyl-γ-butyrolactone. We have, however, obtained other experimental evidence, details of which we will publish elsewhere, which cannot yet be reconciled with the suggested structure for patulin.

Chemotherapeutic investigations have been carried out during the past year in association with Dr. F. C. Happold, Biochemical Laboratories, School of Medicine, University, Leeds. It is hoped that these results will be published in the near future.

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A. L. MORRISON. H. RINDERKNECHT.
A. R. MOSS. J. L. WARD.

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[1] NATURE, 149, 357 (1942).

[2] *Science*, 96, 202 (1942) and *J. Bact.*, 45, 233 (1943).

[3] *Science*, 98, 282 (1943).

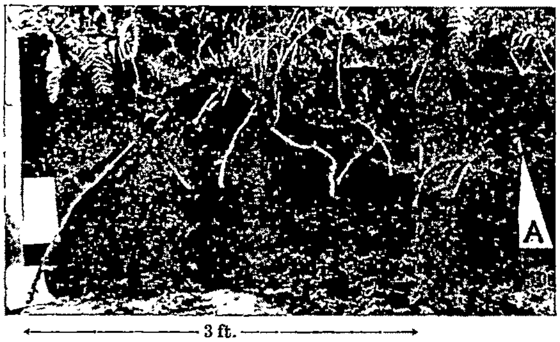
[4] *Brit. J. Exp. Path.*, 23, 202 (1942).

[5] *Lancet*, ii, 625 (1943).

Rate of Growth of Bracken

FOR some considerable time, the widely held belief in the slow development of bracken plants and the initiation of the frond many months in advance of its expansion has been suspect. The idea of the old German morphologists[1,2,3] of the unfolding of one frond and the growth of one internode of the frond-bearing rhizomes in a season does not fit in with the rapid rate of expansion of the plants seen in the field.

In order to test the rate of growth of individual plants, two young sporelings (each 2–3 in. across and bearing some five to six immature fronds) were put into a trough formed by slabs of concrete 3 ft. wide and 2 ft. deep, so arranged as to form a long, narrow, continuous trough some 4 in. across. This was filled with rich soil, so that the sporelings were put under optimum growth conditions. The sporelings were planted out on March 29, 1943, and left until October 11, 1943.



GROWTH OF A BRACKEN SPORELING, PLANTED MARCH 29, PHOTOGRAPHED OCTOBER 10.
The underlying soil has been partially removed to show the numerous branches of the rhizome. *A*, an immature frond, some 8 in. below soil-level.

During that time—as the accompanying photograph shows—growth was very considerable: between August and October, the number and size of the fronds increased very noticeably until they extended over the whole of the 6-ft. trough.

When the concrete slabs at the front were removed, it was found that the rhizomes were ramifying through the whole of the narrow band of soil: so much so, that the rhizome of one plant had already forced its way out between the cracks of the slabs at the base of the trough and was turning towards the damp soil in the hedge-bank alongside; while in the other case, the rhizome had extended to the extremities of the trough and two branches had forced their way through into a partition behind.

One plant was removed from the trough: this was not easy as the rhizomes were overlapping very considerably with the adjacent ones; and at three places, in order to preserve the second plant *in situ*, the rhizome had to be cut. This extracted plant showed a mass of fronds and four main rhizome leaders.

Some of the points that may be noted are:

(*a*) The plant was carrying twenty-two green fronds and a number of withered sporeling ones; also a large number of immature fronds that had not expanded. All the green fronds were of the juvenile rather than the full adult form, and none of them bore spores. On each branch of the rhizome, the largest fronds were those nearest to the distal end of the branch.

(*b*) The lengths of the longest two branches of the rhizome (measured from the central region) were: 55½ in. (141 cm.); 30 in. (76 cm.), so that these gave an overall stretch of exploratory rhizome, after one season's growth, of 85½ in. (217 cm.). These branches were running outwards and downwards from the centre, and appeared to be limited in their downward thrust only by the concrete base of the trough. (There was about 20 in. of soil in the trough.)

(*c*) The number of branch shoots, each with its rhizome branch and frond bud already laid down, was considerable. In many cases, these fronds were so deep (8–10 in.) below the surface that they could not—at the end of the season—force their way up, and had rotted. Under adverse conditions in a hard winter, others may perish similarly; but after a mild winter, since a well-formed rhizome carries large stores of food, fronds already laid down would have an advantageous start in the spring.

(*d*) The initial fronds of the young sporophyte are so small that, unless abundant in the field, they would be overlooked. Moreover, this stage would be seasonal—possibly April–June—for under congenial conditions by July they would have formed plants 1–2 ft. across, which might double themselves by October. Such clumps have been reported in heather, but until now the fact that they could be one year's growth was not recognized. Here, apparently, is one of the explanations of the rapid spread of bracken.

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Nov. 18.

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[1] Hofmeister, W., "Higher Cryptogamia", 222 (Eng. Edn., Ray Soc., London, 1862).

[2] Klein, L., *Bot. Z.*, **42**, 646 (1884).

[3] Sachs, J., "Text Book of Botany", 428 (Eng. Edn., Clarendon Press, Oxford, 1882).

Stimulation of the Milk Production of Dairy Cows by Feeding Thyroid-active Iodinated Proteins

GRAHAM[1], working at the University of Toronto, and afterwards at this Institute[2], demonstrated a marked temporary galactopoietic effect of both orally administered dried thyroid gland and subcutaneously injected thyroxine in dairy cows. This has been confirmed both in Great Britain[3] and in the United States[4]. In 1914 Morse[5] found that the effects of iodinated proteins on the metamorphosis of tadpoles were comparable to those of thyroid, and more recently (1939) Ludwig and von Mutzenbecher have shown[6], and Harington and Pitt Rivers[7] have confirmed, that thyroxine can be isolated from hydrolysates of casein treated with iodine (iodinated casein). The possible use of iodinated casein for the stimulation of milk production in the dairy cow was visualized by Bottomley and Folley[8], who carried out small-scale experiments with cows[9] which indicated that transient increases in milk production could be obtained by feeding iodinated casein.

In view of these results, a detailed investigation of the effect of iodinated protein on the milk production and clinical physiology of the dairy cow was commenced in the summer of 1941 under the auspices of the Agricultural Research Council, and experiments have since been carried out involving 208 dairy cows. Iodinated casein, iodinated whole blood, and iodinated 'Ardein' have been fed to dairy cows, and all three have elicited increases in milk production.

In the early stages of the work, unpalatability of the iodinated proteins and iodine poisoning of the cow were severe limiting factors, and it proved impossible with proteins of low thyroidal activity to obtain a response without the onset of iodism, the symptoms appearing when more than 2·7–3·0 gm. of iodine were fed per day. More active preparations, however, have given more promising results.

'Ardein', a commercial preparation of the ground nut (*Arachis hypogœa*) rich in the globulin, arachin, has been iodinated under semi-commercial conditions, and the iodinated 'Ardein', containing 0·88 per cent acid-insoluble ('thyroxine') iodine has been used in two experiments. When 50 gm. of this material was fed, milk production increased 35 per cent, and fat production 54 per cent. This was accompanied by an increase of 30 per cent in the resting pulse or heart-rate, 34 per cent in the resting respiration-rate, and a slight increase in the rectal temperature. In one of these experiments, no extra food was given to the cows to compensate for the increased metabolism, and, after seven weeks feeding with 50 gm. a day, the cows had lost 115 lb. of body weight or 9 per cent of their original weight. The shape of the weight-loss curve and the condition of the cows suggested that, in the latter stages of treatment, tissue protein was being mobilized to meet the increased energy requirement. Even after seven weeks treatment at such a high level, the clinical abnormalities shown by the cows were not so severe as was expected, and when treatment was stopped live-weight was rapidly regained. The subsequent history, performance, and postmortem appearance of animals subjected to such drastic treatment does not indicate that their health has been impaired.

Iodinated casein has been used in four experiments. It has been found that the response in milk production to a standard dose (30 gm.) of a highly thyroid-active preparation is dependent on the initial level of production of the cow. The response in pounds per day is greater the higher the initial yield ($r = +0{\cdot}7874$), but the percentage response declines with increasing initial yield ($r = -0{\cdot}4668$). As the main factor causing initial yield variation in these experiments was the stage of lactation of the cow, it is thought that response varies with the stage of lactation. This has been confirmed by experiments on the same cow at different lactation stages. The effect of lactation stage is interpreted as indicating a lower state of functional activity per unit of active mammary tissue during late lactation, and a larger amount of active mammary tissue in a higher state of functional activity in early lactation in the normal cow. It has not, however, proved possible to prolong, by iodinated casein feeding, milk production in cows approaching the end of their normal lactation period. Heifers and cows have responded equally well, no response differences have been found between cows at pasture and cows kept on winter rations, and Guernsey and Shorthorn cows have responded in a very similar manner.

It has been found that a dose of 15 gm. daily of iodinated casein increases milk production by approximately 16 per cent and 30 gm. daily by 33 per cent, indicating that the percentage response in milk production is directly proportionate to dosage within this range. The heart-rate increase and the percentage heart-rate increase, however, are nearly trebled by doubling the dosage, this probably indicating that at low dose-levels the increased metabolism is not reflected in an increase in the heart-rate. The relationship between the milk-yield response and the heart-rate response to iodinated proteins of different potencies confirms that at low milk-yield responses the heart-rate responses are proportionally lower than when the milk-yield response is high.

The galactopoietic potencies of iodinated proteins have been expressed in terms of the percentage increase in milk production per gram of iodinated protein fed. Potencies of 0·075 per cent for iodinated blood, 0·543 per cent for iodinated 'Ardein', and up to 1·096 per cent for iodinated casein have been found. There is a distinct, but not exact, relationship between the acid-insoluble ('thyroxine') iodine analysis of iodinated proteins and their galactopoietic potencies, but much better agreement with lactation response is shown by biological assays carried out with Xenopus tadpoles by Dr. A. S. Parkes.

Since the work was commenced, Reineke and Turner[10] have published the results of three-day feeding trials with dairy cows, using their own iodinated casein preparations. The results of these short-term trials also indicate that the milk production of cows can be stimulated by feeding iodinated casein.

The results reported above, together with much additional data on milk composition and the clinical effects of dosage, will be published later. Experiments are now in progress to find whether practical application of the results is possible, especially with regard to winter milk production.

My thanks are due to the Agricultural Research Council for grants in aid of this work.

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Nov. 20.

[1] Graham, W. R., jun., *J. Nutrition*, 1, 407 (1934).

[2] Graham, W. R., jun., *Biochem. J.*, 28, 1368 (1934).

[3] Folley, S. J., and White, P., *Proc. Roy. Soc.*, B, **120**, 346 (1936).

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[5] Morse, M., *J. Biol. Chem.*, 19, 421 (1914).

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[8] Report of the National Institute for Research in Dairying (1940), 35.

[9] Bottomley, A. C., and Folley, S. J., private communication (1941).

[10] Reineke, E. P., and Turner, C. W., *J. Dairy Sci.*, 25, 393 (1942).

A Scientific Directory

In recent months much has been said about the organization of science and, without prejudice to, or support for, any particular formula, there is one direction in which effect can be given in some measure to that aim, namely, in the provision for the British Commonwealth of a directory of scientists along the lines of "American Men of Science"[1]. Such a directory should be available in public libraries and research institutions and should serve to group together, in a manner hitherto entirely overlooked, those members of the community who conduct original investigations in the natural and exact sciences in any of the recognized branches. The concise style of entry, apart from the contentious practice of 'starring', adopted in "American Men of Science" is admirable for conveying the information that scientists have a right to expect to have regarding each other, and much would be gained in reducing the insularity felt by members of one branch *vis-à-vis* those of another.

The responsibility for the production of such a directory is beyond the purview of any of the scientific societies except perhaps the Royal Society, and it might not be too much to hope that the experience gained with the Central (Scientific) Register of the Ministry of Labour during the past few years could be made available for the project envisaged once stable conditions return at the end of the War.

James Walker.

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London, N.W.3.

[1] "American Men of Science, A Biographical Directory". 1st Edn., 1906; 6th Edn., New York, 1938; 7th Edn., in preparation.

RESEARCH ITEMS

Obstructions to the Ascent of Salmon

INFORMATION as to obstructions in Newfoundland and Labrador rivers is summarized in a paper by A. A. Blair, Fisheries Research Laboratory, Newfoundland (Salmon Investigations. 1: Obstructions in Newfoundland and Labrador Rivers. Research Bulletin No. 12 (Fisheries). Department of Natural Resources, St. Johns. Newfoundland Government, 1943). In Labrador the type of obstruction is, in all cases, falls; in Newfoundland, mainly falls, but sometimes shoals and dams. It is suggested that improvements could be made in 9 out of 18 rivers in Labrador, and in 36 out of 81 rivers in Newfoundland. Ready accessibility to spawning grounds is a highly important factor in the maintenance of any stock of salmon, and these obstructions made ascent of salmon difficult or impossible. This collection of data is a valuable one, and will help much in the planning of improvements. Information about Labrador rivers was obtained directly from fur trappers, and about Newfoundland rivers from river wardens. Some of the more accessible obstructions were inspected personally, and of these information is given in greater detail.

A Protozoan Parasite of Freshwater Fish

A. DUNBAVIN BUTCHER has investigated the life-cycle of a ciliate parasite of the rainbow trout, brown trout and carp ("Observations on Some Phases of the Life Cycle of *Ichthyophthirius multifiliis* Fouquet, 1876, a Ciliate Protozoan Parasite of Fresh-Water Fish". *Australian Zoologist*, **10**, Part 2; 1943. Royal Zoological Society of New South Wales). There was a severe outbreak of this so-called 'white spot disease' at the trout hatcheries of the Ballarat Fish Acclimatisation Society in 1939 and 1940. Following this, the author has succeeded in elucidating the complete life-history of the parasite, in spite of the great difficulties incurred in bringing about natural infection of the fishes in aquaria. The total time for the completion of the life-cycle was found to be 13–16 days, which probably accounts for the periodicity of the epidemics. The parasite feeds on the whole cells of its host. The most likely hypothesis for the cause of the death of the fish is probably that the parasite is the source of a toxin which is fatal.

Heterostylism

Linum grandiflorum exhibits the phenomenon found by Darwin that pin-flowered plants are not usually fertilized by pin-flowers, nor thrum by thrum. D. Lewis (*Ann. Bot.*, N.S. **7**, 115; 1943) has discovered that differences in the osmotic pressure of styles and pollen of thrum- and pin-plants will account for the phenomenon associated with heterostyly. The stigma of Linum is placed on one side of the style and is permeable to water, whereas the epidermis of the style is relatively impermeable. On placing in water, the style curls with the stigmatic surface on the convex side. In 30–40 per cent cane sugar there is curling in the opposite direction. The author shows that the pin-style is isotonic with 18 per cent sucrose and the thrum-style with 12 per cent sucrose. Pin-pollen is isotonic with 3 per cent potassium nitrate and thrum-pollen with 5 per cent potassium nitrate. Thus pin-styles have high and pin-pollen low osmotic pressures relative to thrum-styles and pollen respectively. The discovery of Darwin that pin-styles pollinated with thrum-pollen become twisted is shown to result from the abstraction of water by the germinated thrum-pollen from pin-styles. The ratio of osmotic pressures in both legitimate pollinations is 4 : 1, but is 5 : 1 and 7 : 1 in the two illegitimate pollinations. This disparity partly explains the differences in behaviour in illegitimate pollinations—non-germination of pin-pollen and the bursting of thrum-pollen tubes. The author suggests that non-germination of pin-pollen cannot be accounted for, however, by simple osmotic relations, but that imbibition in the early stages of pollen germination is controlled by cell colloids.

Phylogeny and Basic Number in Crepis

THE genus Crepis provides valuable material for the analysis of speciation in relation to chromosome number and morphology. One of the most difficult questions was related to the presence of species with chromosome numbers less than the basic numbers of the genus, which are generally agreed to be 6 and 5 in Crepis. H. A. Tobgy (*J. Genetics*, **45**, 67–111: 1943) has made a thorough and valuable study of the relationships of *C. neglecta* ($n = 4$) and *C. fuliginosa* ($n = 3$). These two species are closely related and will hybridize and give some fertile hybrids. The taxonomic position indicates that *C. fuliginosa* is a derivative of *C. neglecta* or a very similar extinct form. Morphology of the chromosomes in these species, like many other Crepis species, enables each component arm to be identified and followed in the hybrids. Tobgy shows that the *A* and *D* chromosomes of both species form one complex, while the remaining three chromosomes, *B*, *C* from *neglecta* and *B* from *fuliginosa*, form another complex. The interrelationships of the arms of the chromosomes are fully determined, but from the point of view of the reduction in number the behaviour of the *BBC* complex is significant. The *Bn* and *Cn* chromosomes have undergone a reciprocal translocation to give *B* chromosome of *fuliginosa* and a chromosome with the *Cn* centromere. The latter has been lost, since it was genetically inert. The mechanism is somewhat similar to that which originated Dubinin's six-chromosome *D. melanogaster*, and to that suggested by Darlington for such chromosome reduction.

A Direct-Intensity Microphotometer

EXPERIENCE obtained at the Observatory of the University of Michigan in the operation of the ingenious microphotometer installed there has been described by its designers (*Astrophys. J.*, **98**, 43; 1943). The instrument has two plate carriers, on one of which is placed the photograph or spectrogram under examination, and on the other, which can be moved transversely, a calibration photograph, usually an optical wedge or wedge spectrum. This latter is kept in step with the other longitudinally while being moved transversely by automatic means in such a way that the densities of the two plates are always equal. This transverse motion is transferred by means of a cam and mirror to the final trace, which then reproduces directly the relative intensities in the photograph under examination. Line contours in absorption spectra can be reproduced to better than one per cent of the continuum for plate densities between 2·0 and 0·1, while the speed of operation is such that spectrophotometric comparison of two continuous spectra can be carried out at forty wave-lengths over a range of 2500 A. in an hour and a half. The versatility of the instrument allows it to be used with 'standard spot' calibrations, as a transmission microphotometer, and as an isophotometer for use on faint diffuse objects. Many of these applications are illustrated by photographs and the corresponding tracings.

The Coronal Line Spectrum

A NOTE by P. Swings (*Astrophys. J.*, 98, 116; 1943) gives an account of a paper by Edlén (*Z. Astrophys.*, 22, 30; 1942) in which the Swedish spectroscopist publishes fuller details of his recent discovery of the origin of the emission lines in the solar corona. New identifications have been added to those already given (NATURE, 150, 756; 1942): a line occasionally observed at 5536 A. is attributed to A X, and the line at 4359 A. is given, though not with certainty, as due to A XIV; while λ 7059 is identified as due to Fe XV and λ 5694 as perhaps due to Ca XV. The cosmic abundance of argon is not known, but neon is known to be of frequent occurrence, and the ground-term splitting in A X is accurately enough determined to make the identification of λ 5536 very probable. As regards the theory as a whole, the experimental evidence adduced by Edlén from his investigation of the extreme ultra-violet spectra of Fe X, Fe XI, Ca XII and Ca XIII, from his extrapolation of the ground-term splittings in iso-electronic sequences, and from his comparison of transition probabilities with observed intensities, is entirely convincing. There can remain no doubt that the problem of the origin of the coronal lines is now solved. Only four lines (λλ 3454, 4567, 3801 and 4311) remain unidentified, the last two being very faint; all the rest belong to forbidden transitions in the highly ionized atoms of iron, nickel, calcium and argon.

Magnetochemistry

IN the ninth Liversidge Lecture (*J. Chem. Soc.*, 328; 1943) S. Sugden discusses some recent applications of measurements of magnetic susceptibilities to the elucidation of structure. The modern quantum theory has greatly clarified the interpretation of magnetic data, but difficulties arise when quantitative comparisons are made between theory and experiment. In considering molecules the contribution of resonance to the susceptibility becomes significant, and for more complex molecules only semi-empirical methods are available. Prof. Sugden discussed several examples. The effect of temperature and the significance of orbital moments were dealt with, some cases in which the latter cannot be neglected being mentioned. The applications to co-ordination compounds were treated and some difficulties in the present state of the theory which are outstanding were pointed out. The lecture gives an interesting and balanced survey of the subject with which it deals.

Polymorphism of Arsenious Oxide

THE common crystalline form of arsenious oxide (As_4O_6) is octahedral, but a monoclinic form was discovered by Wöhler in 1832 and there is also a glassy amorphous form. The system was investigated by Rushton and Daniels in 1926 by measuring the vapour pressures of the two crystalline forms, estimating the melting points as 275° for the octahedral and 315° for the monoclinic. J. H. Schulman and W. C. Schumb (*J. Amer. Chem. Soc.*, 65, 878; 1943) have made a further investigation of the system, including solubility, heats of transformation and X-ray and crystallographic measurements. They conclude that the monoclinic form is thermodynamically stable with respect to the more common octahedral form at temperatures as low as 2°, the transition temperature being approximately − 13°. Water vapour is effective in accelerating the transformation of octahedral to monoclinic As_4O_6 at 180°, whereas vapours of many other substances were found to be ineffective. The preparation of three new forms assumed by Smits and Beljaars (1931) was attempted without success.

Autoxidation of Ascorbic Acid

THE availability of ascorbic acid (vitamin C) is diminished through destruction by autoxidation. R. W. Peterson and J. H. Walton (*J. Amer. Chem. Soc.*, 65, 1212; 1943) have shown that in the absence of copper very slow autoxidation occurs below $pH = 8 \cdot 0$; it increases above this value, and in highly alkaline solution the rate is extremely high. In presence of copper the reaction occurs readily in both acid and alkaline solution. A marked autocatalysis was observed in the presence of copper. Hydrogen peroxide is among the products of the reaction. The inhibiting effects of many substances were determined. Except sodium citrate, all the appreciably effective substances contained one or more amino groups and one or more acid groups. In general, an increase in the number of acid groups or the number of amino groups increased the inhibiting effect. None of the compounds inhibited the reaction in the absence of copper.

Spectra of New Stars

AN important publication by Dean McLaughlin (*Pub. Obs. Univ. Mich.*, 8, No. 12; 1942) draws a generalized picture of the spectroscopic development of a typical nova, and suggests a physical interpretation of the observations which is new in some respects. A thorough survey of the course of seven bright novæ enables the author to compare the corresponding stages in their development in a way hitherto impossible to the reader of the many previous descriptive papers, owing to the absence of an agreed terminology. Five systems of absorption lines and seven of emission lines are distinguished, many of them existing concurrently. Fluctuations in the light curve are correlated with spectral changes and with velocity changes; and an attempt is made to reconcile the various temperature determinations. It is significant that the variations of temperature found are almost exactly the opposite of what would be expected were the outburst due to a simple heating and subsequent cooling of the surface of a star. The changes are interpreted as due to a continuous emission of stellar material from a thin superficial layer at a rate which varies much as the light emission does, reaching a maximum just before light-maximum and dropping sharply soon after. The velocity of the ejection is not necessarily related to this rate, and indeed reaches its maximum long afterwards. The older theory of the successive emission of discrete shells is abandoned in favour of one in better accord with present ideas of what constitutes the photosphere of a nova. The question of the source of the energy released below the surface of the star is left open.

THE SPANISH IRON AND STEEL INDUSTRY

N a recent issue of *Dyna* (Revista de la Asociacion Nacional de Ingenieros Industriales de España) a aper by Señor F. Millan on "Spanish Metallurgy ince the National Movement", read at Barcelona omewhat earlier, is given in full. It is confined ntirely to iron and steel and steel manufactures.

After the War of 1914–18, production of Spanish on and steel gradually increased until, in 1929, that pig iron was about 722,000 tons and of steel just er 1,000,000 tons. It declined, of course, rather stically during the revolution, but in recent years recovered somewhat, though not up to the 1929 el. In 1942 pig iron was about 500,000 and steel ,000 tons. The most serious difficulties in the way real progress are lack of good metallurgical coke d scrap, to which must now be added a lower rade of native ore.

Until recently Spain had been noted for the high uality of its iron ores, with up to 60–70 per cent etallic iron content; but the average percentage ppears now to be in the neighbourhood of 40 per ent, and it has larger contents of sulphur and hosphorus. In 1940 output of ore was nearly 000,000 tons, but domestic consumption was only st over 1,000,000 tons and exports almost negligible, that large stocks accumulated at the mines, many f which had to close down at least for a time, and roduction during the first half of 1941 was only 97,000 tons. Before the revolution more than 0 per cent of the output had been exported to England, Germany and Belgium, the red hæmatites eing particularly in demand. The chief mines are n Vizcaya, Santander, Granada, Teruel, etc. An nteresting account of some of the magnetic iron ores f El Teuler and one or two other places has been iven by H. Quiring (*Z. prakt. Geologie*, **46** and **47**; 938–39). Geological estimates of the remaining eserves, after allowing for 325 million tons mined, re roughly 700 million tons. So far as Vizcaya, the chief mining centre, is concerned, the bulk of the remaining ores are carbonates with only about 30 per cent hæmatite. The carbonates are rather high in sulphur (up to 1·7 per cent) and the hæmatites in silica. The iron content of the latter, too, is only about 40 per cent. This all adds to the amount of coke required in smelting, of which there is already insufficient supply.

Although the manganese ore deposits are fairly considerable in places, such as those in Huelva and Teruel, output is very low. Thus in 1940 it was only 6,850 tons of ore, to be increased, it was hoped, to 10,000 tons in 1943. Metallic manganese content ranges from 37 per cent in Huelva to 53 per cent in Buferrera.

Spain has also considerable supplies of native coal, but not very much of it appears to be of the right kind for metallurgical coke production. At the Geological Congress at Toronto it was estimated that Spain's coal reserves were some 8,768 million tons, of which three fourths would be bituminous. Some of the principal coal centres are in Asturias, Teruel, Leon, and Palencia. The Spanish coal output in 1929 was 7½ million tons, and 2 million tons were imported together with nearly 300,000 tons of coke. Native coal production has increased somewhat in recent years, up to about 10 million tons in 1942, despite shortage of equipment, such as explosives and timber; and owing to the practical impossibility of importing good coke from Great Britain and Germany, native coal had to be used for the purpose, to the extent of 500,000–600,000 tons of coke. Much of this native-made coke, however, has a high ash content, up to 16 per cent or more, as compared with only 8 per cent in good English coke.

Yet another difficulty, to which reference has been already made, is the shortage of scrap for steelmaking. Attempts have been made to overcome these difficulties—lack of coke and of scrap—by means of the Krupp-Renn process, introduced into Germany about 1933–34, and fully described by Johannsen (*Tech. Mitt. Krupp Forschungsber.*, and also *Stahl u. Eisen*, 1934 and 1939). This method, in which huge rotary furnaces are used, something like cement kilns, is claimed to be particularly suitable for low-grade ores and can be used with almost any kind of fuel, including powdered coal or lignite. The ore is first reduced to a pasty condition, and then at a temperature below its melting point is converted into low-carbon compact lumps embedded in slag, from which the lumps are separated by a crushing process.

In his later paper (Sept. 1939), Johannsen included not only direct production of steel but also the application of the method to the reduction of non-ferrous ores. At that time it appeared there were about eighteen Renn furnaces in operation, but not more than half a dozen were in Germany; most of the others had been sent to Japan, where the process is more largely used than in Germany itself, probably due to the low grade of ore with which Japan has for the most part to be contented. According to latest reports, Japan is at present using eleven of these furnaces, of which four are in Manchukuo and seven in Japan and Korea. It is stated that six more were recently under construction in Manchukuo.

So far as Spain is concerned, progress in this matter has been rather slow. Apart from a concession granted to the Soc. Gen. de Electro Metalurgia to instal one of these plants in Aviles, Asturias, for an output of 30,000 tons of steel a year (to be doubled later) little else has been done, although the Instituto Nacional de Industria has sent a special mission to Germany to study the Renn process. According to Señor Millan, a trial plant may be put up in Vizcaya.

Señor Millan seems to be of the opinion that, if it is seriously intended to make Spain self-supporting in regard to iron and steel production, the best hopes lie in the direction of the so-called sintering (*sinterizacion*) methods, now so largely used in Germany with low-grade ores—to the extent of 35 million tons of ore in 1943; and he deals with these possibilities at some length, including the proposed adoption of the Sturzelberg and Norwegian Tysland hole methods.

Señor Millan includes a review of some of the principal Spanish producers of iron and steel, of which the chief is the well-known Soc. Altos Hornos de Vizcaya, with a capital of 250 million pesetas, and a maximum total capacity of nearly 700,000 tons p iron a year. It has its own coal mines, coking pla , by-product recovery plant, rolling mills, etc. Several other fairly large companies are noted, and an interesting point about many of them is the increasing attention being given to manufactured steel, for which purpose many new rolling mills and other technical equipment have been installed in recent years.

SOVIET WAR-TIME SURGERY

WHEN four British surgeons flew to the U.S.S.R. and stayed there for three weeks, they were given a great welcome and were taken not only to medical institutions in Moscow but also up the line so far forward as Vyazma to study the field and mobile hospitals. They learned that the Soviet surgeons have no new fundamental principles to teach us and do not need to learn any from us; their principles are the same as ours and differ only in the details of their application[1]. But young Russian surgeons would benefit from a study of our best hospital practice and our young surgeons would learn much from the Russian clinics. The methods of some Russian surgeons are notable. Prof. Yudin, for example, apart from his remarkable operation for replacement of the obstructed œsophagus by the jejunum, differs somewhat in his use of the skin-tight plaster for the treatment of war wounds. This method has been attributed to the Soviet surgeon Pirogoff, who, when he was short of splints in the Crimean War, cut out sailcloth to the patterns required and dipped these in plaster. This closed-plaster method was developed by Trueta in the Spanish Civil War. The closed-plaster method has been also attributed to Trueta himself, to Winnett-Orr in the United States, to Mettita in Italy and to Ollier in France.

While neither Soviet nor European anæsthetic practice is so good as it is in Great Britain or the United States, the Soviet system of blood transfusion was found by our visiting surgeons to be beyond criticism and it is done on a huge scale[3]. In one Moscow institution alone 500–800 donors are bled every day and 90 per cent of them are women. Donors get extra rations and also pay, but four-fifths of the money is returned for war purposes. There is never any lack of blood; it is flown to the front and has even been flown to Soviet wounded behind the German lines.

Another valuable feature of the Soviet Army Medical Service is the practice of sorting out all types of case in clearing stations five miles behind the firing line. This is done by an experienced surgeon and the cases are then sent to specialist hospitals, where they are treated by specialists in the kind of injury from which they are suffering. But before they are sent away they receive immediate treatment from young members of surgical teams, who are trained to give the treatment which the senior specialists expect them to have had. The clearing stations immediately behind the front are well equipped and each has a series of special units complete in itself. Perhaps this system—and the tough Russian constitution—has helped the Russians to return 70 per cent of their wounded to the firing line. Some of its features were shown in a film given to the Royal College of Surgeons last October[4]. This film was made two years ago. It showed the rescue of wounded by sledge, the method of giving each patient a bath, a shave and a general clean-up, and some of the methods of rehabilitation of function after injuries. It also showed some of the wards, which are less formal than those in British military and other hospitals.

The Russian military nurse awoke the admiration of the visiting surgeons. She not only does her job very well but also helps to build the hospital in which she works, cutting down trees, squaring up timber, making the frames of windows and doors and digging foundations. The British surgeons were impre her skill in camouflage. On one occasion they in what appeared to be a forest; it turned be the entrance to a hospital containing a th beds. Some of the buildings had been built the trees, which projected through the roofs is reminded of a certain medical unit at M Basra, during the War of 1914–18, at which t huts were built round the palm trees in this the palm trunks made useful wardrobes.

The medical service of the U.S.S.R. is becor woman's service, 90 per cent of the doctor under training being women. They take a fiv course, while a nurse's course has been reduce three years to two.

The British surgeons were also much impre the emergency medical service in Moscow, the ization of which recalls the organization National Fire Service in Britain. Moscow is di into areas, a map of which enables telephone oper detailed for night duty to send, within a few mi in response to a call for medical help, a well-equi ambulance, with a doctor, a nurse and an or to the house requiring them. The central op uses a device which illuminates on the map city the street from which the call comes and the nearest ambulance depot, with which she communicates. There would appear to be no r why cities in Britain should not be supplied with valuable service.

Soviet military ophthalmology has recently described by Prof. Kolen, head of the Novosil Eye Clinic[5]. Evidently it is obtaining good re in its treatment of the dangerous and distre injuries which involve not only the all-important but also the neighbouring organs and the fac general. Wound-healing by the transplant of tissues is also widely practised[6]. Dead ti treated with chloraclyde are used as an ai healing up fresh and granulating wounds, regeneration is stimulated with emulsions embryonal tissue obtained from guinea pigs used in castor oil as a liquid base.

G. LAPAG

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[1] *Lancet*, 198 (Aug. 14, 1943).

[2] *Lancet*, 485 (Oct. 16, 1943).

[3] *Brit. Med. J.*, 208 (Aug. 14, 1943).

[4] *Lancet*, 487 (Oct. 16, 1943).

[5] *Lancet*, 804 (June 26, 1943).

[6] *Science*, 97, 162 (1943).

UTILIZATION OF BAMBOOS I INDIA

AS is well known, in tropical and subtropi countries where the bamboo in one or m of its many genera and species flourishes, man, represented by the local population, has over v long periods of time made extensive use of it—in fa from house construction down to the provision of woman's household utensils and even part of clothing. The bamboo has probably been as serv able in an all-round fashion to man as any ot single vegetable product. It is of interest, therefor follow its more modern uses by civilized man has long discarded its former utilitarian ones.

In a Utilisation brochure issued by the Fo Research Institute, Dehra Dun (*Indian For. Rec.*, Res. Pub., Dehra Dun, 1943), V. D. Limaye descr some investigations into "Bamboo Nails, Manufacture and Holding Power". The investi commenced owing to the fact that wire nails had ome very difficult to obtain in India, while the de- ad for packing cases, not least for army require- ats, had increased enormously. Experiments were ried out to see how bamboo nails compared in hold- power and other qualities with wire nails. The ults of the tests are given; and sketches of large- production of bamboo nails are included and the ss of manufacture described.

uly India is a fortunate country when her care- supervised forest wealth enables her to confront ifficulty after another in times of dire stress h the work of her research officers. "It has und", says the author, "that glued bamboo ave a greater holding power than plain iron der a steady pull. But when shocks and rtation hazards are met with, their holding diminishes". A small percentage of iron nails acking case is, therefore, necessary, especially xing the battens by clinching. It was found ctual tests that if 25 per cent iron nails and er cent bamboo nails are used, a strong and eable box results, with a very considerable saving ts of manufacture.

ther use of the bamboo has been found in the facture of pill or ointment boxes. Due to a age of metal, various substitutes have had to be in the construction of containers; thus plywood iners have already been mentioned in NATURE *For. Leaf.* 24 and 26). In Leaflet 39 (1943) Sultan mmed discusses the method of making from boo small pill and ointment boxes. Details of ufacture are given including some information uitable coatings and linings. It is said that a y competent turner will find no difficulty in ing these boxes with the aid of a lathe and ordin- ools. The description is of interest: "A bamboo iner consists of a short length of bamboo (accord- o size of container required) which forms the of the body and lid of the container. The top the bottom are made of thin three plywood and rovided with a locking device so that, if the becomes loose due to climatic changes, the lid still be held tight. The container is usually coated inted, both inside and outside, with the object tarding the absorption of moisture by sealing pores of the bamboo, and to give a smooth clean sh."

THE SCIENCE OF TOMATO GROWING

HE Cheshunt Experimental and Research Station has devoted its energies during war-time wholly the elucidation of problems connected with food ps. Reports of investigations on the tomato upy most of the twenty-eighth annual report, for 2, of the Station (from the director, Dr. W. F. vley, The Nursery and Market Garden Industries' elopment Society, Ltd., Turner's Hill, Cheshunt, ts, 1943). Trials of the value of muriate of potash gainst sulphate of potash resulted in a small, gh scarcely significant, increase of crop in favour he sulphate. No harmful foliage effects were rved when muriate was added, and it would that widespread doubts about the suitability of ate of potash for the indoor tomato crop are dispelled.

h research has been devoted to diseases and pests of the tomato. Two varieties, Manx Marvel and Riverside, showed significant resistance to the wilt fungus *Verticillium albo-atrum*. Tomato stem-rot caused by the fungus *Didymella lycopersici* caused widespread damage in 1942 to plants growing in the greenhouse and in the open. The disease appears to be carried from crop to crop on wire supports and strings, and may be controlled by suitable methods of hygiene. Experiments have also been made with fungicides as soil treatment, or applied as sprays and dusts to the plant, or as a protection of the 'collar', where infection normally occurs in greenhouse tomatoes.

Control of the wireworm pest by trapping with carrot bait gave rather disappointing results, and the elimination of these larvæ still remains one of the outstanding problems of pest control. Other negative results were obtained with sprays containing tartar-emetic and glycerine, advocated in the United States against the red-spider mite, and with potassium iodide solution for the prevention of damage by the root-knot eelworm.

Tomatoes in sand culture exhibited clear-cut symptoms when deprived of boron, manganese and magnesium. Omission of boron and magnesium from the culture solution produced marked stunting, and boron deficiency caused a leaf scorch similar to that sometimes associated with acute potassium starvation. Lack of magnesium induced a withering of the tips of leaflets, whereas the absence of manganese brought about a mottling of the leaf with uniform yellow specks. The report contains details of these and other investigations in the form of short papers by the authors of each subject for research.

HYDROGEN EXCHANGE REACTIONS

IN two papers (*J. Chem. Soc.*, 361, 367; 1943) H. V. A. Briscoe and co-workers describe the results of experiments on the interchange of hydrogen isotopes with complex salts, ammines of cobalt, and platinum and palladium being studied. The hydrogen of $[Co(NH_3)_6]\,Cl_3$ and $[Co\ en_2]\,Cl_3$ (en = ethylenediamine) undergoes isotope exchange with heavy water (D_2O) in solutions, the interchange following a unimolecular law with a rate inversely proportional to the hydrogen ion concentration but practically independent of the ammine concentration or its deuterium content. The exchange mechanism is explained by assuming that the metal ammine group $M—NH_3$ can ionize as an acid: $M—NH_3 = M—NH_2' + H^{\cdot}$, this being parallel to the ionization of aquo-ammines, which form hydroxo-ammines. There is some evidence that the case of acid dissociation runs parallel with the stability of the ammines. The reaction mechanism is very fully discussed in the papers on the basis of the kinetics.

The rate of interchange of hydrogen isotopes with ammines of different metals decreases in the order Co > Pt > Pd and runs parallel to the complex ions. In the case of $[Pd(NH_3)_4]\,Cl_2$ the interchange mechanism is complex; in addition to the acid dissociation mechanism, it reacts in acid solution by reversible dissociation of ammonia from the complex. This points to a continuous gradation between the two extreme types of ammonia complexes represented by the stable metal ammines of the $[Co(NH_3)_6]\,Cl_3$

type and the unstable ammoniates of bivalent cobalt, nickel, copper, etc. The function of the nitrogen atom of the ammonia molecules as a centre of co-ordination has perhaps not been sufficiently emphasized in the past, and its tendency to assume a configuration similar to that of the ammonium ion in the stable compounds, which then dissociate as substituted ammonium salts, should apparently also be taken into account.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Tuesday, December 28

Royal Institution (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Prof. E. N. da C. Andrade, F.R.S.: "Vibrations and Waves", 1: "Vibrations".*

Thursday, December 30

Royal Institution (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Prof. E. N. da C. Andrade, F.R.S.: "Vibrations and Waves", 2: "Wave Properties in General".*

Friday, December 31

Institution of Mechanical Engineers (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Mr. A. J. Philpot: "Paints and Protective Finishes for Metals".

Saturday, January 1

Royal Institution (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Prof. E. N. da C. Andrade, F.R.S.: "Vibrations and Waves", 3: "Sound Waves".*

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Technician for the Veterinary Laboratory—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (December 28).

Master to be responsible for the teaching of Mathematics at the Bristol Junior Technical School—The Chief Education Officer, 2 Cecil Road, Clifton, Bristol 8 (December 29).

Assistant Lecturer in the Mining Department—The Principal, County Mining and Technical School, Nuneaton, Warwickshire (December 31).

Principal (temporary) of the Bridgend Mining and Technical Institute and Junior Technical Schools—The Director of Education, County Hall, Cardiff (January 3).

Assistant Master to teach Mathematics in the Day School—The Clerk to the Governors, South-East Essex Technical College and School of Art, Longbridge Road, Dagenham, Essex (January 3).

Master or Mistress (temporary) for Science, including Elementary Biology—The Clerk to the Governors, South-West Essex Technical College and School of Art, Forest Road, Walthamstow, London, E.17 (January 3).

Assistant (part-time) in Speech Training in the Department of Education—The Registrar, The University, Manchester 13 (January 10).

Science Master, mainly for Chemistry, up to University Scholarship standard, at the City of London School—The Town Clerk, 55–61 Moorgate, London, E.C.2 (January 12).

Chair of Chemistry—The Principal, University College of Wales, Aberystwyth (January 15).

Regius Professor of Zoology at Glasgow University—The Private Secretary, Scottish Office, Fielden House, 10 Great College Street, London, S.W.1 (January 17).

Demonstrator in Anatomy (male)—The Secretary, Guy's Hospital Medical School, London Bridge, London, S.E.1.

Laboratory Steward for the Chemistry Department—The Principal, Coventry Technical College, Coventry.

Assistant Inspectors I and II (covering Groups A and B) for posts (London and Provinces) in a Government Department. For Group A posts sound technical and practical training in Mechanical Engineering is required, preferably in Heavy or Marine Engineering or in Modern Engineering Production Methods; for Group B posts sound technical and practical training and experience in Mechanical Engineering is required, with special knowledge of Foundry Practice, the Nut and Bolt Industry, the Metallurgy of Ferrous and Non-Ferrous Metals, or the Armour Plate Industry—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.1952A, and grade and group for which application is being made).

Works Engineer (Order No. 275) with good experience in Plant Maintenance (including Electrical) and Lay-outs of New Projects required; a Metal Shops Superintendent (Order No. 262), with Machine Shop experience essential and Coppersmith experience desirable; an Assistant Chief of Production Control (Order No. 274), must be thoroughly conversant with Engineering Procedure and Operation of Works Documents, with good administrative ability and experience in dealing with large staff—The Ministry of Labour and National Service, A.O., 16 Westwood Road, Southampton (quoting appropriate Order No.).

Plantation Assistants in the Cameroons under the Custodian of Enemy Property, Nigeria—The Ministry of Labour and Nation Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Referenc No. F.1888).

Lecturer (temporary) in the Department of Building and Structural Engineering—The Principal, Central Technical College, Suffolk Street, Birmingham 1.

Chief Planning Engineer at a well-known Airframe Manufacturing Concern in the London area—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.1951XA).

Graduate Assistant Master to teach General Science with Mathematics in Day Technical School and Evening Institute—The Principal, Technical Institute, 28 Beckenham Road, Beckenham, Kent.

Assistant Lecturer to teach Engineering Subjects, including Science, Mathematics and Drawing to day and evening students—The Principal, Forest of Dean Mining and Technical School, Cinderford, Gloucestershire.

Assistant Master or Mistress to teach Geography, and an Assistant Master for Engineering Subjects, at the Burton-upon-Trent Technical Institute and Junior Technical School—The Secretary and Director of Education, Education Offices, Guild Street, Burton-upon-Trent.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Geological Survey of Great Britain. Wartime Pamphlet No. 13: Limestones of Scotland, Area 8: Orkney and Shetland. By D. Haldane: with Analyses by H. G. M. Hardie. Pp. 13. (London: Geological Survey and Museum.) 9*d*. [1111

Imperial Bureau of Animal Breeding and Genetics. Gestation Periods: a Table and Bibliography. Compiled by J. H. Kenneth. Pp. 23. (Edinburgh and London: Oliver and Boyd, Ltd.) 2*s*. [1711

Iron and Steel Institute. Special Report No. 29: Review of the Work of the Joint Research Committees 1924–1943 of the Iron and Steel Institute and the British Iron and Steel Federation. Pp. viii+176. (London: Iron and Steel Institute.) [1111

Transactions of the Royal Society of Edinburgh. Vol. 61, Part 1, No. 3: Cytological Studies in the Genus Solanum, 1: Wild and Native Cultivated "Diploid" Potatoes. By Dr. H. C. Choudhuri. Pp. 113–136. 3*s*. Vol. 61, Part 1, No. 4: Inheritance of Resistance to Two Strains of Blight (*Phytophthora infestans* de Bary) in Potatoes. By Dr. William Black. Pp. 137–148. 1*s*. 6*d*. (Edinburgh and London: Oliver and Boyd, Ltd.) 1*s*. 6*d*. [1211

Transactions of the Royal Society of Edinburgh. Vol. 61, Part 1, No. 1: The Genus Primula, Section Farinosae. By Sir W. Wright Smith and Dr. H. R. Fletcher. Pp. 69. (Edinburgh and London: Oliver and Boyd, Ltd.) 8*s*. 6*d*. [1911

Other Countries

Indian Forest Bulletin. Utilisation (New Series), No. 120: Studies in Permeability. Part 1: A Preliminary Note on the Permeability of Wood and other Materials to Air. By D. Narayanamurti and A. Purushotham. Pp. 16+3 plates. 6 annas; 7*d*. Indian Forest Leaflet. Utilisation, No. 40: Studies on Adhesives, Part 4: Further Note on Prolamin Adhesives. By D. Narayanamurti and V. Ranganathan. Pp. ii+14. 6 annas; 9*d*. Utilisation, No. 43: Air Condenser Kiln suitable for the Seasoning of Cooperage Woods and Packing Case Timbers. By M. A. Rehman. Pp. ii+6+1 plate. 6 annas; 9*d*. Utilisation, No. 45: Preliminary Studies on Improved Wood, Part 2: Laminated Wood. By D. Narayanamurti and Kartar Singh. Pp. 8+6 plates. 6 annas; 9*d*. (Dehra Dun: Forest Research Institute.) [1410

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Bulletin of the American Museum of Natural History. Vol. 81, Art. 4: Fossil Lizards of Mongolia. By Charles W. Gilmore. Pp. 361–384+plate 52. (New York: American Museum of Natural History.) [1910

Academia das Ciências de Lisboa: Biblioteca de Altos Estudos. Relações científicas entre Portugal e a Grã-Bretanha. Por H. Amorim Ferreira. Pp. viii+76. (Lisboa: Academia das Ciências.) [1910

Carnegie Institution of Washington: Department of Terrestrial Magnetism. Scientific Results of Cruise VII of the *Carnegie* during 1928–1929 under command of Captain J. P. Ault. Biology, 3: Studies in the Morphology, Taxonomy and Ecology of the Peridiniales. By Herbert W. Graham. (Publication 542.) Pp. vii+129. 1.50 dollars. Meteorology, 1: Meteorological Results of Cruise VII of the *Carnegie*, 1928–1929. By Woodrow C. Jacobs and Katherine B. Clarke. (Publication 544.) Pp. v+168. 1.50 dollars. Meteorology, 2: Upper-Wind Observations and Results obtained on Cruise VII of the *Carnegie*. By Andrew Thomson. (Publication 547.) Pp. vii+93. 75 cents. (Washington, D.C.: Smithsonian Institution.) [2010

Proceedings of the American Philosophical Society. Vol. 87, No. 1 (July 14, 1943): The Early History of Science and Learning in America; Papers read before the American Philosophical Society, Midwinter and Autumn Meetings, 1942. Pp. iii+120. (Philadelphia: American Philosophical Society.) [2010

Brooklyn Botanic Garden Record. Vol. 32, No. 3: The Medicinal Plant Garden of the Brooklyn Botanic Garden. (Guide No. 16.) Pp. 165–210. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) 25 cents. [2210